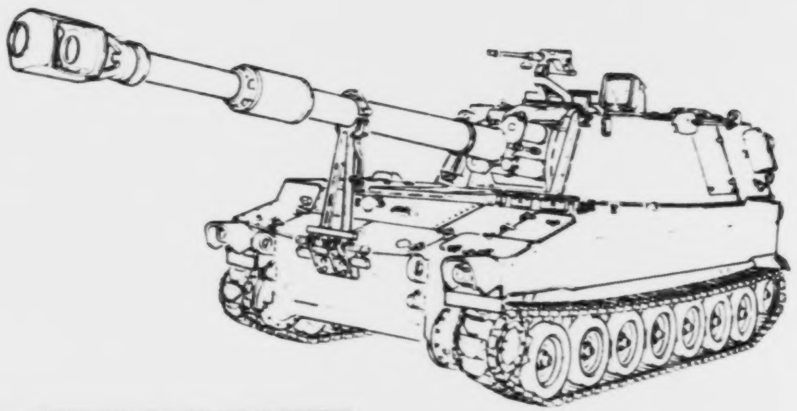
9-2350-311-34-2/990

TM 9-2350-311-34-2

DEPARTMENT OF THE ARMY
TECHNICAL MANUAL
FOR
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
FOR
CAB, ARMAMENT, ELEVATING AND TRAVERSING SYSTEMS, AND ASSOCIATED COMPONENTS
HOWITZER, MEDIUM, SELF-PROPELLED: 155MM,
M109A2 (2350-01-031-0586)
M109A3 (2350-01-031-8851)

This manual supersedes:
TM 9-2350-303-34-2, 15 May 1981
and
TM 9-2350-217-34/2, 29 October 1964.



HEADQUARTERS, DEPARTMENT OF THE ARMY

This copy is a reprint which includes current pages from Change 1.

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NOVEMBER 1986

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READEX FICHE best copy available

WARNING

CARBON MONOXIDE POISONING CAN BE DEADLY

Carbon monoxide is a colorless, odorless, deadly poisonous gas, which, when breathed, deprives the body of oxygen and causes suffocation. Exposure to air contaminated with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, coma. Permanent brain damage or death can result from severe exposure.

It occurs in the exhaust fumes of fuel-burning heaters and internal-combustion engines and becomes dangerously concentrated under conditions of inadequate ventilation. The following precautions must be observed to insure the safety of personnel whenever the personnel heater, main or auxiliary engine of any engine of any vehicle is operated for maintenance purposes or tactical use.

Do not operate heater or engine of vehicle in an enclosed area unless it is adequately ventilated.

Do not drive any vehicle with inspection plates, cover plates or engine compartment doors removed unless necessary for maintenance purposes.

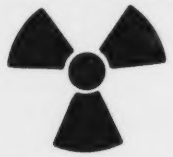
Be alert at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, immediately ventilate personnel compartments. If symptoms persist, remove affected personnel from vehicle and treat as follows: Expose to fresh air; keep warm; do not permit physical exercise; if necessary, administer artificial respiration.

THE BEST DEFENSE AGAINST CARBON MONOXIDE

POISON IS ADEQUATE VENTILATION.

WARNING

RADIATION HAZARD



TRITIUM GAS (H3)

RADIOACTIVE MATERIELS

M140 alinement device and M1A1 collimator are illuminated by sealed radioactive sources of tritium gas H3. As long as these sources remain sealed they do not emit any harmful radiation. There is no limit on handling time. Radioactively illuminated collimators are indicated by the radioactive sign shown above. If seal is broken, see below:

If there is no light present in a low light atmosphere or if the lens is broken, the local Radiological Protection Officer (RPO) must be notified. The damaged collimator must be taken right away to a direct support maintenance unit. If you have touched any area which may be contaminated as a result of leakage or breakage, wash right away with soap and lukewarm water. The purging parts of sealed collimator must not be removed.

A. Rules and Regulations: Copies of the following rules and regulations are maintained at HQ. AMCCOM, Rock Island, IL. 61299-6000. Copies may be requested, or information pertinent to these rules and regulations obtained by contacting the AMCCOM Radiological Protection Officer (RPO), Autovon 793-2964. Commercial (309) 782-2964.

1. 10CFR Part 19-Notices. Instructions and Reports to Workers: Inspections
2. 10CFR Part 20-Standards for Protection Against Radiation.
3. NRC License, License Conditions and License Application.

B. Safety Precautions: The radioactive materiels used in these instruments are tritium gas H3 sealed in pyrex tubes. They pose no significant hazard to the repairman when intact. These sources illuminate the instrumentation for night operations. Tampering with or removal of the sources in the field is prohibited by federal law. In the event there is no illumination, notify the local Radiological Protection Officer. Do not attempt to repair or replace the instrument in the field. If skin contact is made with any area contaminated with tritium, immediately wash with nonabrasive soap and water.

C. Identification: Radioactive self-luminous sources are identified by means of radioactive warning labels (as above). These labels should not be defaced or removed and should be replaced immediately when necessary. Refer to the local RPO or the AMCCOM RPO for instructions on handling, storage or disposal.

D. Storage: When radioactively illuminated instruments are defective, these items must be placed in a plastic bag and packaged in the shipping container. Spare equipment must be stored in the shipping container, as received, until installed on the weapon. Storage of these items is recommended to be in an outdoor shed-type storage or unoccupied building.

WARNING

- Do not purge and charge any instrument containing a radioluminous source if there is no illumination in the assembly. The local Radiological Protection Officer (RPO) must be notified and the defective unit will be replaced by a serviceable one.

- Do not use mineral spirits or paint thinner to clean the howitzer. Mineral spirits and paint thinners are highly toxic and combustible. Prolonged breathing can cause dizziness, nausea and even death. Do not use these materials.

- Avoid prolonged contact with cleaning solvents and adhesives. To prevent damage to eyes, skin and lungs:

  Always use cleaning solvents and adhesives in a well-ventilated area.
  Do not permit smoking. Do not use near open flame.
  Avoid contact with skin.
  Wear gloves and eye protection.

- When removing and installing heavy items, make sure to have sufficient personnel and adequate lifting equipment. Equipment can cause serious injury if dropped.

WARNING

Refer to FM 21-11, First Aid for Soldiers, for correct procedures to be taken if personnel are injured.

Do not drop tank of compressed nitrogen gas. Do not tap nitrogen tank. Tank can explode when tapped or dropped. When using in confined areas, use extreme care; gas could cause suffocation.

High pressure gas is used in charging the accumulators and fire control equipment. Do not exceed recommended psi when charging these components. Keep face and body clear of release valves. Failure to observe safety precautions may result in injury or death.

TECHNICAL MANUAL

NO. 9-2350-311-34-2

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC 14 November 1986

DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
FOR
CAB, ARMAMENT, ELEVATING AND TRAVERSING SYSTEMS, AND ASSOCIATED COMPONENTS
HOWITZER, MEDIUM, SELF-PROPELLED:

155MM,
M109A2 (2350-01-031-0586)
M109A3 (2350-01-031-8851)
M109A4 (2350-01-277-5770)

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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-MAS, Rock Island, IL 61299-6000. A reply will be furnished to you.

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HOW TO USE THIS MANUAL

a. The content of this manual is limited to:

1 Information on Cab, Armament, Elevating and Traversing Systems and Associated Components.

2 Only those maintenance and repair tasks authorized above Battalion Level (Direct Support and General Support). These tasks are listed in TM 9-2350-311-20-2 Maintenance Allocation Chart, Appendix B. Direct Support tasks show in column 4F. General Support tasks show in column 4H.

b. This manual consists of:

1 An introductory chapter of the 155MM, self-propelled howitzer, M109 series. This chapter explains administrative instructions and forms, and contains a nomenclature cross-reference list and a section on differences between models. The final section presents equipment data and equipment descriptions.

2 A general maintenance chapter detailing instructions for various types of inspection, including pre-embarkation inspection for units alerted for overseas movement, general maintenance practices and illustrated troubleshooting.

3 Eleven maintenance chapters outlining maintenance procedures for cab components. Chapters are arranged in functional group order.

c. To find information quickly:

1 The front cover is keyed to black boxes at the edge of the pages.

2 A more detailed Table of Contents is on page ii.

3 Each chapter has its own Table of Contents.

4 An alphabetical index is on page Index-1 in the back of manual.

5 An illustrated troubleshooting section is provided on pages 2-25 thru 2-74.

CHAPTER 1 INTRODUCTION

GENERAL

This chapter provides the maintenance technician with basic information of the M109 series primary armament, elevating, traversing and other cab-related components. This information is provided through a physical description of major components, which the technician is required to maintain, service, inspect, replace, or repair.

Additional information is provided as reference and guidance on use of forms, maintenance of records and filing reports.

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INTRODUCTION – Section I. General Information

1-1. SCOPE

This manual contains instructions for direct and general support level maintenance on the howitzer primary armament, elevating and traversing systems as well as other cab-related components.

Appendix A lists references which are applicable to the M109 series Howitzer.

Appendix B is a list of special tools and equipment needed to perform maintenance functions described in this manual.

Appendix C lists expendable/durable supplies and materials required to support the M109 series maintenance functions.

Appendix D provides electrical and hydraulic schematics for howitzer cab.

Appendix E provides an illustrated list of fabricated items.

1-2. MAINTENANCE ALLOCATION

The prescribed maintenance responsibilites as allocated in the Maintenance Allocation Chart (MAC) (TM 9-2350-311-20-2) are reflected in this manual. In all cases where nature of repair, modification, or adjustment is beyond the scope and/or facilities of direct support and general support maintenance, depot maintenance unit should be informed in order that trained personnel with suitable tools and equipment may be provided or further instructions issued.

1-3. MAINTENANCE FORMS, RECORDS AND REPORTS

For a listing of authorized Department of the Army forms and for instructions on how to use these forms, refer to the Army Maintenance Management System DA PAM 738-750.

Accidents involving injury to personnel or damage to materiel will be reported on DA Form 285 (Accident Report) in accordance with AR 385-40.

Any accident or malfunction involving use of ammunition must be reported in accordance with AR 75-1.

1-4. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750-244-6 for procedures on how to destroy howitzer. You will find procedures for destruction of munitions in TM 750-244-5-1 (Conventional Ammunition and Improved Conventional Munitions).

1-5. CALIBRATION

For fire control alinement tests and measurements, refer to TM 9-2350-311-10.

For illustration and description of how to synchronize, adjust and test M109 series sighting and fire control equipment, ref. TM 9-2350-311-20-2.

For further information, refer to the following technical manuals as necessary:

TM 9-1240-401-34 for DS/GS Maintenance on:
M117/M117A2 Telescope
M145 Mount
M118A2 Telescope
M146 Mount
M42 Periscope
RPSTL for above items is contained in TM 9-1240-401-34P.

Maintenance procedures and RPSTL for M15 Elevation Quadrant are contained in TM 9-1290-322-34 and TM 9-1290-322-34P. For maintenance of M1/M1A1 Collimator, ref. TM 9-1240-324-34 & P.

1-6. NOMENCLATURE CROSS-REFERENCE LIST

Nomenclature in this manual was chosen in accordance with terms used for provisioning as they appear in RPSTL and MAC (ref. TM 9-2350-311-20-2 and TM 9-2350-311-34P-2).

A few cab components, however, are frequently referred to by terms more common than those in the RPSTL. In many cases the more common name is a shorter name for same component.

INTRODUCTION – Section I. General Information–Continued

1-6. NOMENCLATURE CROSS-REFERENCE LIST

OFFICIAL PROVISIONING NOMENCLATURE	MORE COMMON NAME
Ballistic cover assembly	Panoramic telescope (PANTEL) ballistic cover
Bladder assembly	Accumulator bag
Cab ammunition rack	Ammo rack
Caliber .50 machinegun M2	Machinegun M2
Control assembly, left gunner's	Left gunner's control
Control assembly, right gunner's	Right (assistant) gunner's control
Electrical arm	Electrical contact arm or contact arm
Electrical arm holder assembly	Brush holder
Electrical contact segment ring	Slip ring segment board
Elevation mechanism assembly (equilibrator)	Elevating cylinder
Howitzer M178 mount	M178 mount
M185 cannon assembly	Cannon
155MM medium self-propelled howitzer M109A2/M109A3/M109A4	Howitzer
Selector valve assembly	Elevation selector valve
Spindle assembly	Obturator group or bump spindle
Tube assembly	Cannon tube
Valve assembly, actuating rammer	Rammer actuating valve
Valve assembly, safety	Blocking valve

1-7. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S)

EIR's must be submitted by anyone who is aware of an unsatisfactory condition with equipment design or use. It is not necessary to show a new design or list a better way to perform a procedure. Simply tell why the design is unfavorable or why a procedure is difficult. EIR's will be submitted on Standard Form 368. Mail directly to Commander, US Army Armament Munitions and Chemical Command, Attn: AMSMC-QAD, Rock Island, Illinois 61299-6000. We'll send you a reply.

NOTE

When equipment failure occurs, but it is not caused by normal wear, poor operation or accident, you must submit an equipment improvement recommendation.

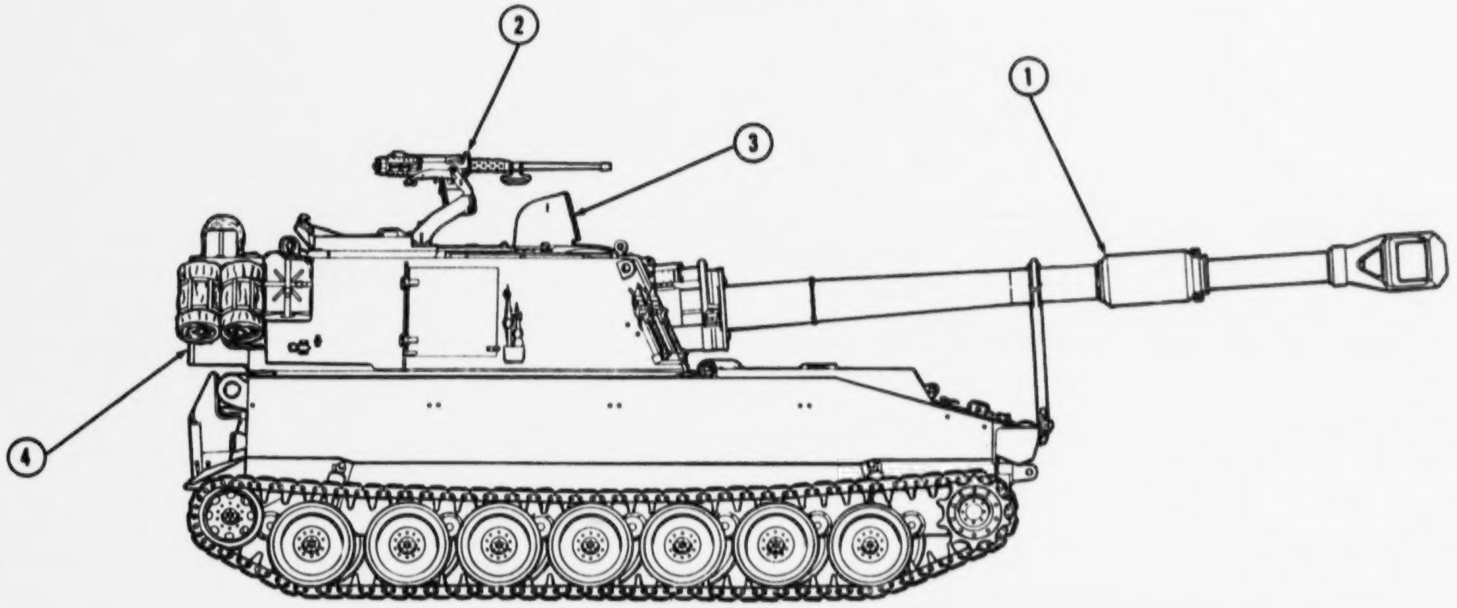
1-8. ADMINISTRATIVE STORAGE

Requirements for administrative storage are covered in TM 9-2350-311-20-2.

INTRODUCTION – Section II. Equipment Description and Data

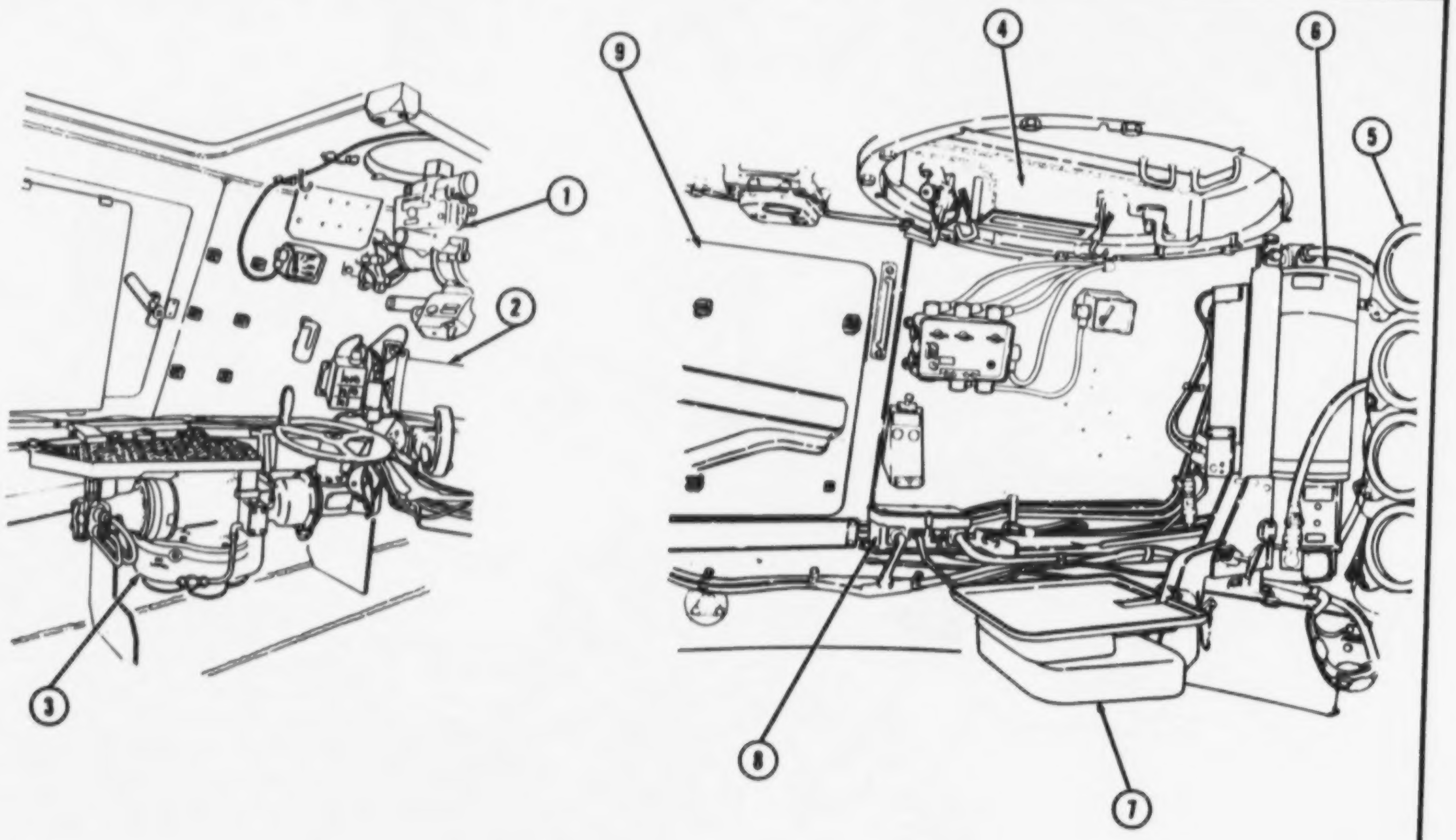
1-9. EQUIPMENT LOCATION

CAB EXTERNAL



Legend

1. 155MM cannon assembly
2. .50 caliber machinegun M2, heavy barrel
3. Ballistic cover, panoramic telescope
4. Stowage – external (bustle)



CAB INTERNAL

Legend

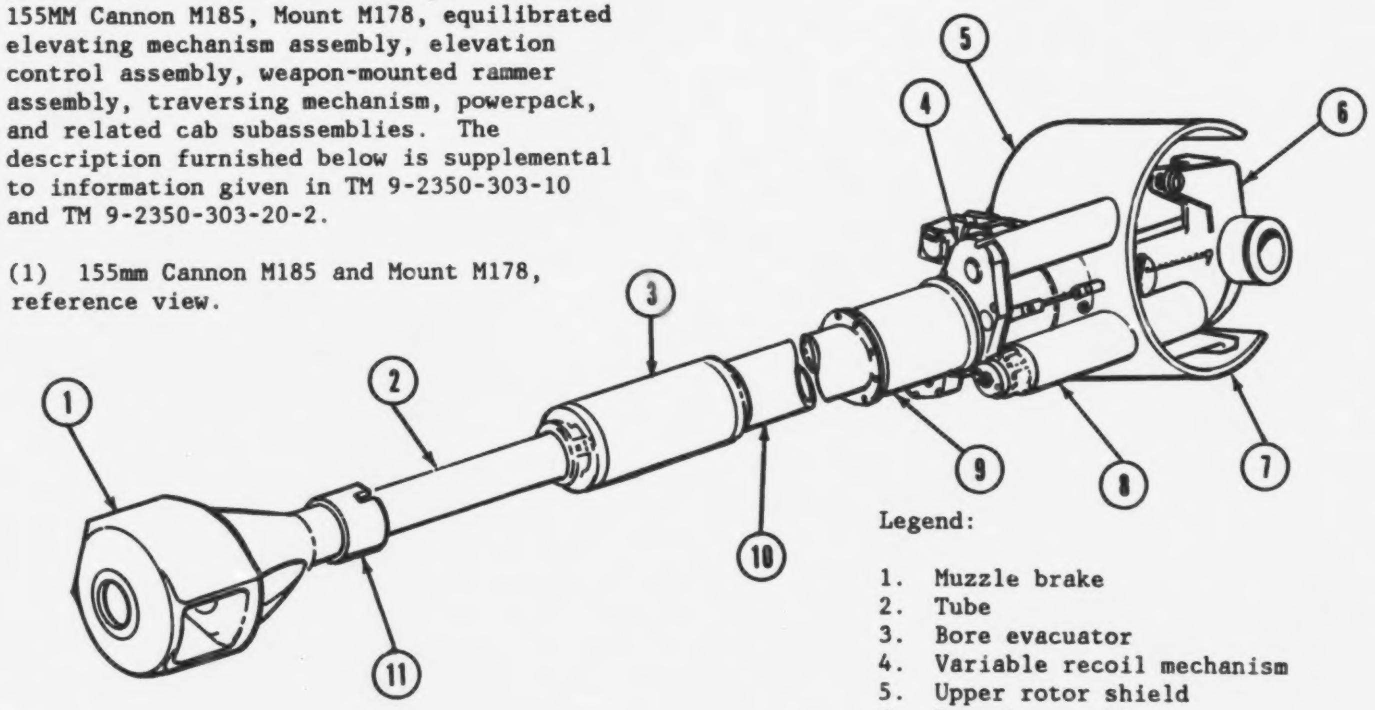
1. Sighting equipment
2. Equilibration accumulator
3. Traversing mechanism
4. Cupola assembly, commander's
5. Cab ammunition rack
6. Powerpack and hydraulic reservoir
7. Seat, commander's
8. Electrical system power relay box
9. Side door assembly

1-9. EQUIPMENT LOCATION — Continued

b. Description of Major Components.

This section covers the description of the 155MM Cannon M185, Mount M178, equilibrated elevating mechanism assembly, elevation control assembly, weapon-mounted rammer assembly, traversing mechanism, powerpack, and related cab subassemblies. The description furnished below is supplemental to information given in TM 9-2350-303-10 and TM 9-2350-303-20-2.

(1) 155mm Cannon M185 and Mount M178, reference view.



Legend:

1. Muzzle brake
2. Tube
3. Bore evacuator
4. Variable recoil mechanism
5. Upper rotor shield
6. Breech assembly
7. Lower rotor shield
8. Recuperator
9. Dust shield
10. Ball valves (hidden under evacuator)
11. Thrust collar

(2) 155mm Cannon

The principal components of the cannon M185 are as follows:

(a) Tube (1)

The tube incorporates a chamber designed to receive the projectile and powder charge and is rifled throughout the length of the bore to assure accuracy of trajectory. Interrupted threads are machined on the outside diameter at breech end of tube to facilitate mounting of the tube in the breech ring. Further machining adapts tube for mounting evacuator and muzzle brake.

(b) Breech ring (2)

The breech ring and band (3) connect the tube and recoil system and mount the breech mechanism.

(c) Bore evacuator (4)

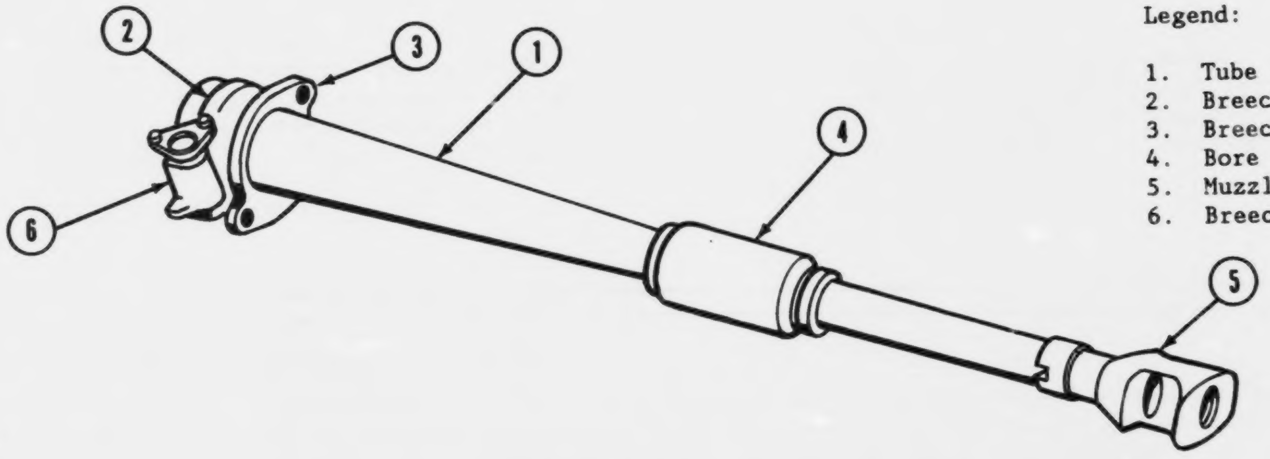
The bore evacuator clears tube of gases after a round has been fired, thereby preventing contamination of air inside cab.

(d) Muzzle brake (5)

The muzzle brake reduces forward muzzle flash and recoil while expelling gases to the sides to increase visibliity for crew.

(e) Breech assembly (6)

The breech assembly contains the tube chamber, locking mechanism and firing mechanism. The principle components of the breech assembly are the breechblock, carrier, operating crank, obturator, firing mechanism and operating handle. The semiautomatic screw block-type breech mechanism is designed for separate loading ammunition.



Legend:

1. Tube
2. Breech ring
3. Breech ring band
4. Bore evacuator
5. Muzzle brake
6. Breech assembly

INTRODUCTION – Section II. Equipment Description and Data–Continued

1-9. EQUIPMENT LOCATION – Continued

a. Breechblock

Breechblock (1) encloses projectile and powder charge within chamber and remains in closed position until opened by breech operating cam during latter stages of counter recoil cycle.

b. Carrier

Carrier (2) mounts breechblock (1) and firing mechanism (5). A system of springs and gears within carrier (2) opens and closes breechblock (1). Breechblock (1) is opened by power transmitted through gearing from operating crank (3). Compression-type coil springs transmit power through gearing to lock breechblock (1) after it has been closed by torsion from laminated closing springs.

c. Operating crank

Operating crank (3), mounted on breech ring rides within camming recesses machined in breech operating cam. A portion of counter recoil force is converted by action of cam and crank to torque which is transmitted to carrier (2) gearing.

d. Obturator

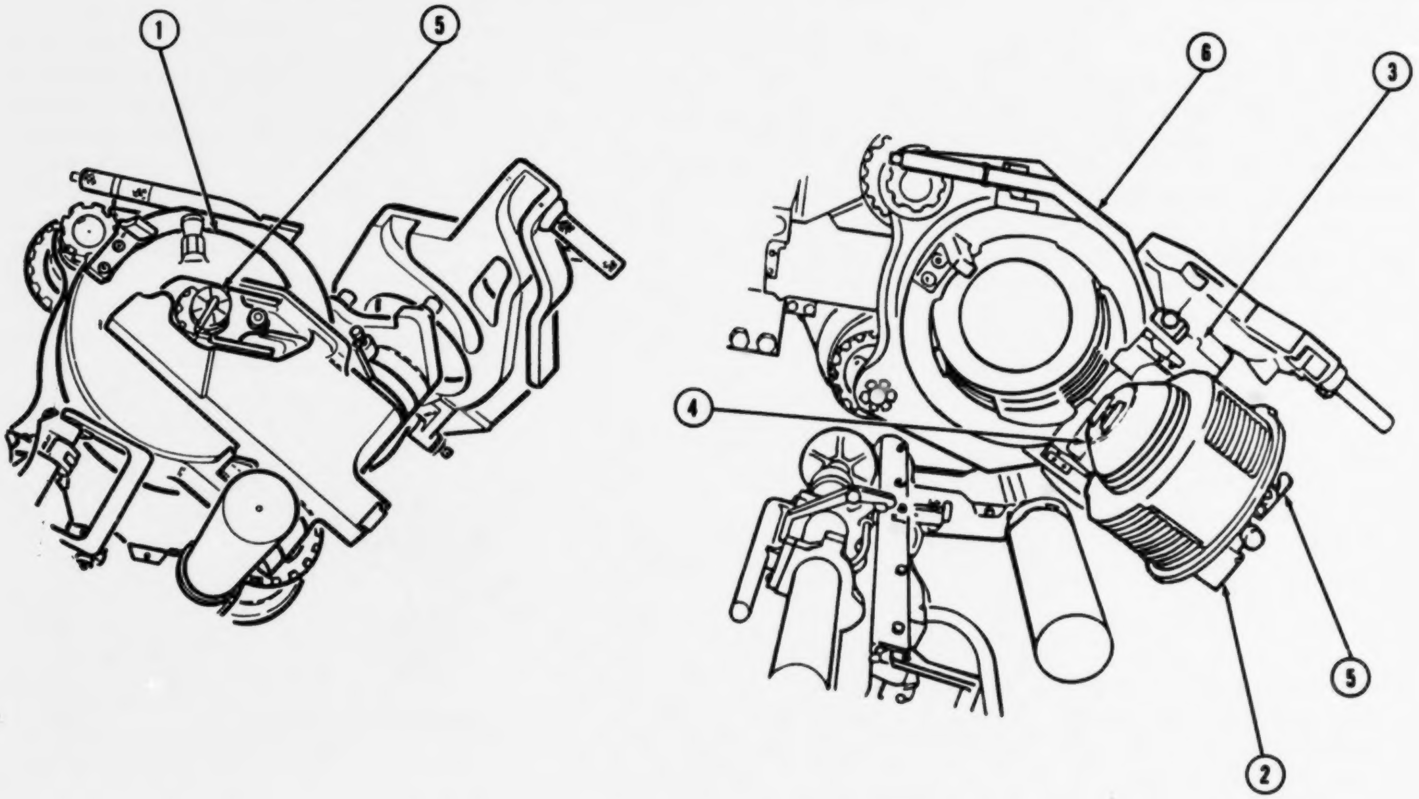
Obturator group (4), mounted on forward face of breechblock (1), serves as a seal between chamber and breechblock (1), preventing entry of gases from chamber to cab at time of firing.

e. Firing mechanism

Firing mechanism (5) is a continuous pull, percussion type. Impact force is transmitted through a firing pin in block assembly which strikes a percussion-type primer, detonating propellant powder charge.

f. Operating handle

Operating handle (6) connected to operating crank (3) allows manual opening and closing of breech mechanism and is normally kept in stowed position, latched to operating handle (6) stop.

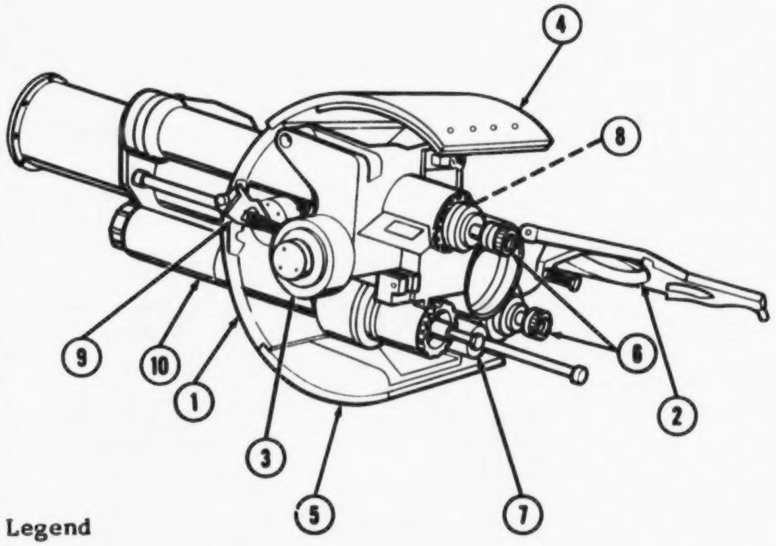


Legend

1. Breechblock
2. Carrier
3. Operating crank
4. Obturator
5. Firing mechanism
6. Operating handle

INTRODUCTION – Section II. Equipment Description and Data–Continued

1-9. EQUIPMENT LOCATION – Continued



Legend

1. Cradle
2. Breech operating cam
3. Trunnion bearing
4. Upper rotor
5. Lower rotor
6. Variable recoil cylinders (2)
7. Buffer cylinder
8. Replenisher accumulator (ref. page 1-15)
9. Actuator
10. Recuperator cylinder

g. Mount M178

Mount secures 155MM cannon to vehicle cab. It permits the cannon to be elevated or depressed within prescribed limits and to slide rearward and forward on machined surfaces during recoil and counter recoil cycles. Major components of M178 mount are as follows:

1 Cradle

The cradle (1) is a machined casting in which cannon rides and which carries the components of variable recoil systems, breech operating cam (2), trunnion bearings (3) and recuperator cylinder (10).

2 Breech operating cam

The breech operating cam (2) is a flat plate with camming surfaces machined into it and is hinged to the cradle (1). The breech operating cam (2) having assisted in unlocking and opening breechblock, holds it open after weapon returns to battery. When breech operating cam (2) is lifted manually from contact with operating crank, breechblock is allowed to close and lock automatically.

3 Trunnion bearings

Trunnion bearings (3), mounted on sides of cradle (1), are attached to cab by trunnion bearing brackets and caps and carry weight of cannon and mount. This permits cannon to be elevated and depressed within limits set by stops welded to mount.

4 Upper and lower rotors

The upper rotor (4) and lower rotor (5) are heavy aluminum plate extensions bolted to gun shield. These aluminum plates function to inhibit effects of enemy fire.

5 Variable recoil system

Variable recoil system compensates for cannon's tendency to recoil violently after firing. Principle components of recoil system are buffer cylinder (7), variable recoil cylinders (6), replenisher accumulator (8) and recuperator cylinder (10). The variable recoil cylinders (6) are governed by an actuator (9) which shortens length of recoil in relation to extent of weapon's elevation. In effect, a shorter recoil is allowed for higher elevations.

a Variable recoil cylinders

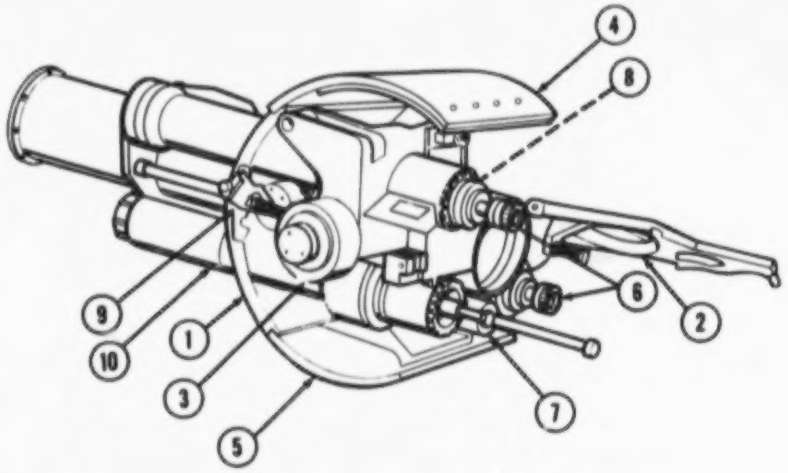
Variable recoil cylinders (6) operate hydraulically to restrict recoil length and are attached to cradle (1) and breech ring band. Pistons contain orifices to allow fluid to flow from one side of piston to other during recoil. Orifices are tapered to provide a progressively greater restriction of flow as weapon approaches full recoil. Rotation of inner orifices regulates length of recoil. During counter recoil, these same orifices permit a return flow of fluid past piston.

b Buffer cylinder

Recuperator cylinder (10) tends to slam weapon into battery. Buffer cylinder (7) functions to govern slamming action and eases weapon into battery. Buffer cylinder (7) operates hydraulically and contains a spring-loaded piston which is free to move rearward during recoil. Buffer cylinder (7) is filled with hydraulic fluid which passes freely through a flutter valve in the piston during rearward movement. During counter recoil, flutter valve closes and piston rod contacts forward face of breech ring band. Fluid flow is now permitted only through three orifices in flutter valve. Restriction of fluid flow by piston effectively counteracts slamming action of recuperator cylinder (10).

INTRODUCTION – Section II. Equipment Description and Data–Continued

1-9. EQUIPMENT LOCATION – Continued

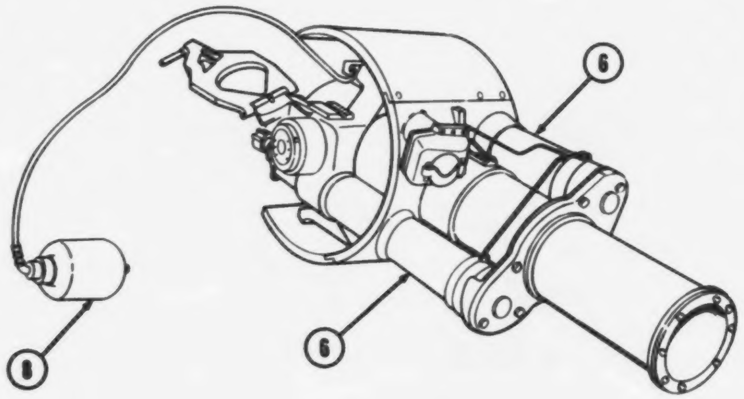


c Actuator

Orifices in variable recoil cylinders (6) and pistons are alined to provide a predetermined orifice area. Actuator (9) which is sensitive to elevation or depression of cannon, functions through gearing to alter orifice opening within variable recoil cylinders (6). Shorter recoil results from reduced orifice opening.

Legend

1. Cradle
2. Breech operating cam
3. Trunnion bearing
4. Upper rotor
5. Lower rotor
6. Variable recoil cylinders (2)
7. Buffer cylinder
8. Replenisher accumulator
9. Actuator
10. Recuperator cylinder



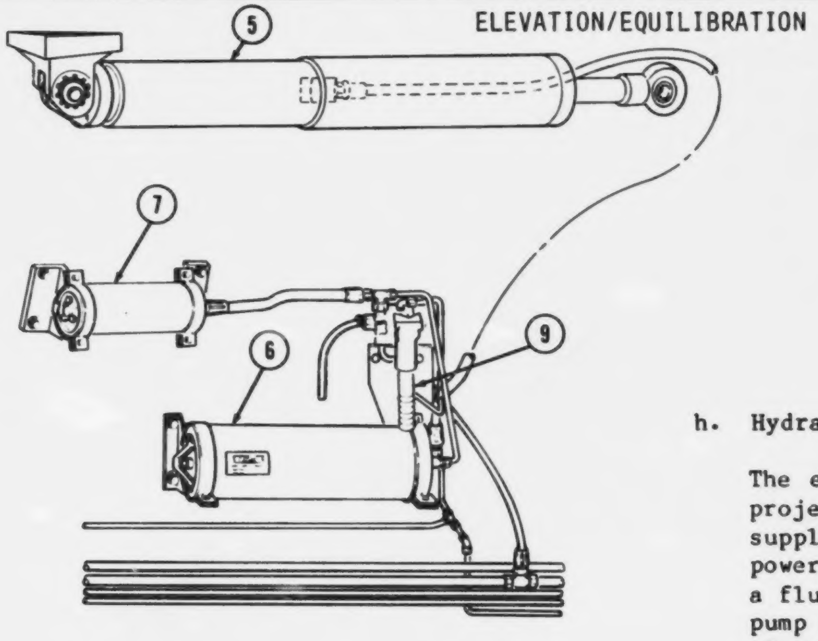
d Replenisher accumulator

Replenisher accumulator (8) functions to maintain proper hydraulic fluid level in buffer cylinder (7) and variable recoil cylinders (6). Hydraulic fluid is forced through tubes to buffer cylinder (7) and variable recoil cylinders (6). A gas valve supplies pressurized hydraulic fluid. Replenisher accumulator (8) is located in right front of cab, mounted to the wall.

6 Recuperator cylinder

The recuperator cylinder (10) operates pneumatically and returns weapon from full recoil to battery position. During recoil, a piston (connected to breech ring band) moves within recuperator cylinder (10) against a preload of 700 ± 50 psi (4826 ± 345 kPa) of nitrogen at 70°F (21°C). When recoil force is spent, nitrogen pressure working against piston returns cannon to battery.

1-9. EQUIPMENT LOCATION – Continued

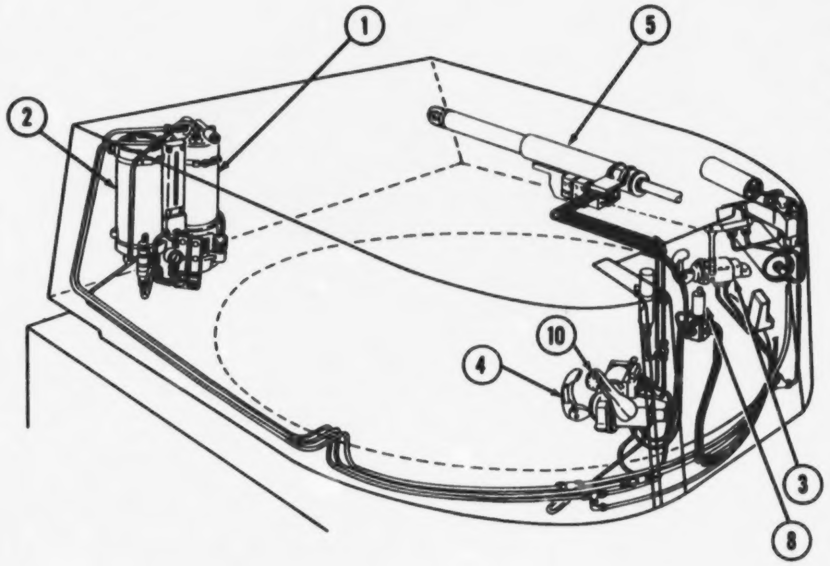


Legend

1. Powerpack
2. Main hydraulic accumulator
3. Gunner's Control
4. Assistant Gunner's Control
5. Elevating cylinder
6. Primary accumulator
7. Secondary accumulator
8. Elevation selector valve
9. Hand pump
10. Manual elevating hand pump

h. Hydraulic systems, cab

The elevating system, traversing system and projectile rammer hydraulic systems are supplied with pressurized hydraulic fluid by powerpack (1). Top part of powerpack (1) is a fluid reservoir which contains a hydraulic pump driven by an electric motor in the base of the powerpack (1). Immediately next to powerpack (1) is the main hydraulic accumulator (2) which insures constant hydraulic pressure during operation of any hydraulic system.



Elevating system is used to elev ress and balance cannon. System ma rolled from either gunner's control (istant gunner's control (4). System of elevating cylinder (5), prima mulator (6), secondary accumulator (7) vation selector valve (8) and hand pu) for adjusting balance of elevating inder (5). Manual elevating hand pump (10) ounted on right control (4) provides ability to operate system in the event of hydraulic power failure.

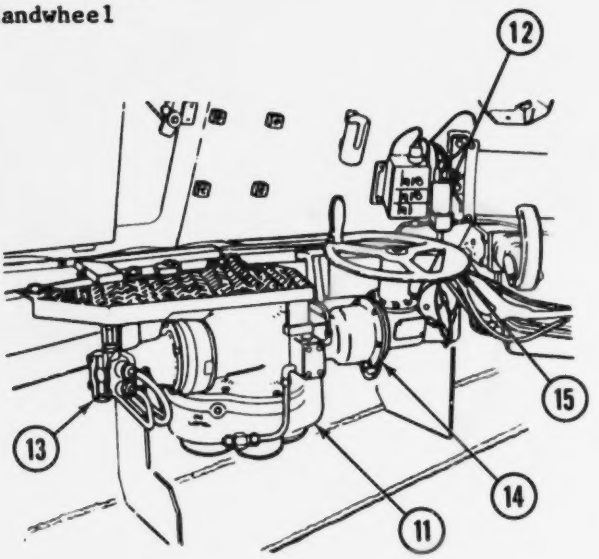
INTRODUCTION – Section II. Equipment Description and Data–Continued

1-9. EQUIPMENT LOCATION – Continued

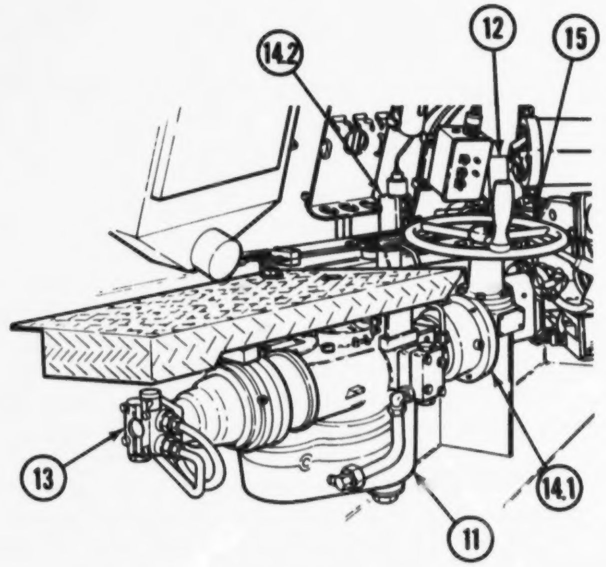
CAB TRAVERSING SYSTEM

Legend

11.	Traversing mechanism
12.	Bypass valve
13.	Hydraulic motor
14.	Electric clutch
14.1.	Hydraulic clutch
14.2.	Clutch valve
15.	Handwheel



TRAVERSING MECHANISM (M109A2/M109A3 MODELS)

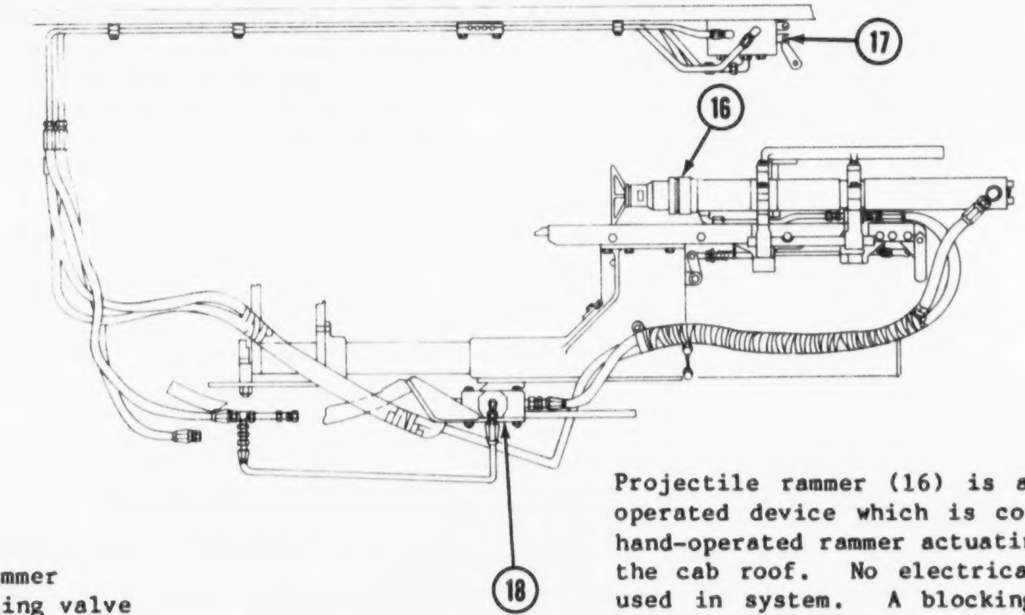


TRAVERSING MECHANISM (M109A4 MODELS ONLY)

h. Hydraulic systems, cab-Continued

Cab traversing system consists of a traversing mechanism (11) and bypass valve (12). Traversing mechanism (11) is driven by a fixed-displacement hydraulic motor (13) through either an electrically operated clutch (14) (M109A2/M109A3 models) or a hydraulic clutch (14.1) (M109A4 models). Hydraulic pressure is transmitted through a clutch valve (14.2) to hydraulic clutch in M109A4 howitzers. In the event of solenoid or electrical control circuit failure, the clutch valve can be operated manually to activate hydraulic pressure. The bypass valve (12), when activated by the gunner, allows only manual operation of traversing mechanism (11). A handwheel (15) is used to operate the traversing mechanism (11) manually.

RAMMER SYSTEM



Legend

16. Projectile rammer
17. Rammer actuating valve
18. Blocking valve

Projectile rammer (16) is a hydraulically operated device which is controlled by a hand-operated rammer actuating valve (17) on the cab roof. No electrical circuits are used in system. A blocking valve (18) prevents rammer from being operated unless it is correctly alined with the firing chamber of the cannon.

1-9. EQUIPMENT LOCATION – Continued

i. Overall electrical system, cab (Appendix D)

The cab uses a 28 volt DC electrical system with power furnished from the hull. Electrical contact is made with bus bars fastened to a 1/5th segment of the hull race ring. Power reaches the cab through whichever one of the five cab electrical contact arm assemblies (2) happens to be in contact with the bus bars on the hull. Three intercom lines and two telephone lines go directly to the cab amplifier (8). The cab power line comes into the power relay box (3) and power is distributed through four principle circuits:

(a) Wire 100, main cab power, to the gunner's selector switch box 1 for ON/OFF control of all power to the cab, MANUAL/POWER control of traverse, elevation control, and lighting circuits. Wire 100 also provides power to the nuclear, biological, and chemical (NBC) protection system in M109A4 howitzers.

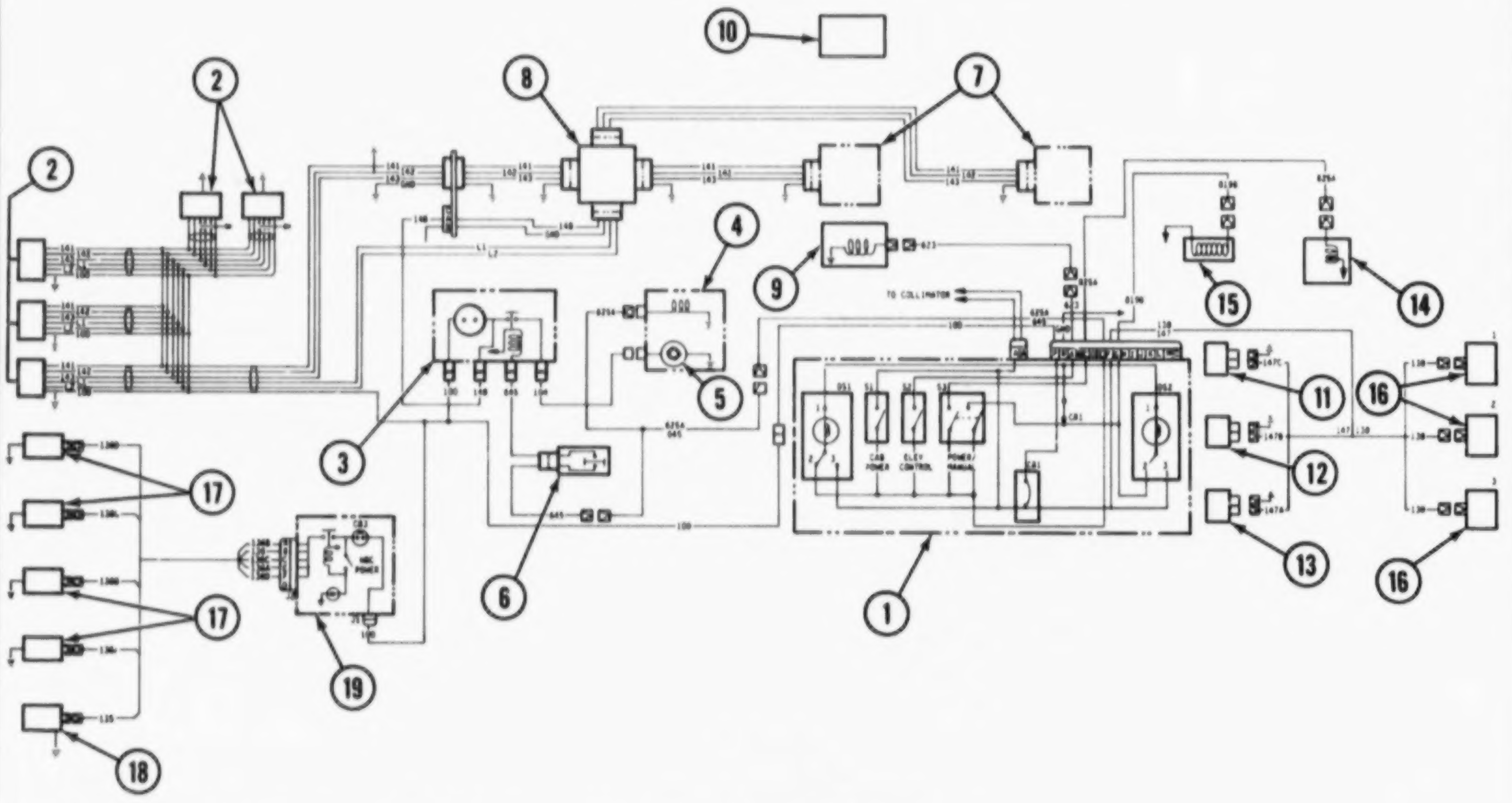
(b) Wire 148, radio/intercom amplifier (8) power

(c) Wire 645, pressure switch in main accumulator (6) for control of powerpack motor

(d) Wire 104, power for powerpack motor (4)

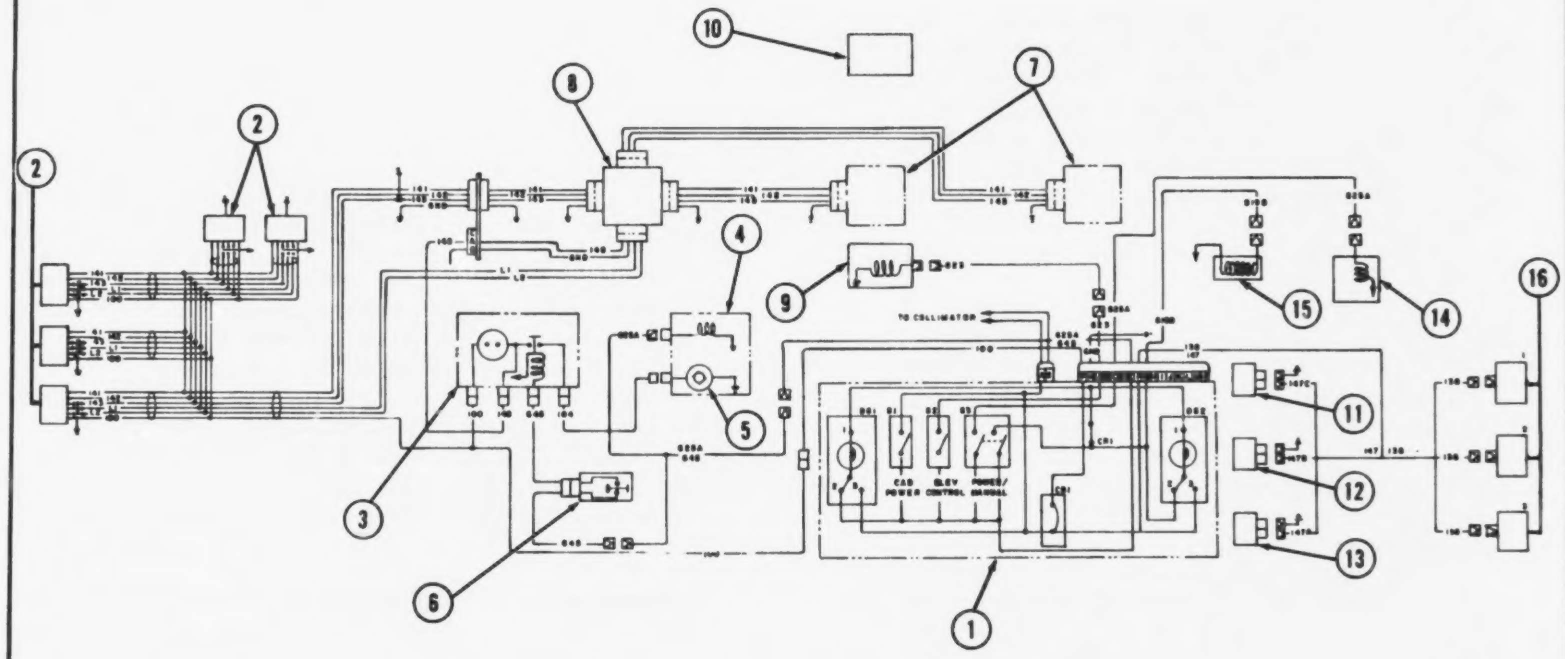
(e) Wire 141, 142, 143, L1, and L2 intercommunications/telephone circuits

OVERALL ELECTRICAL SYSTEM BLOCK DIAGRAM, CAB (M109A4)


10
2
8
7
2
4
9
TO COLLIMATOR
15
14
3
5
11
16
12
17
6
CAB POWER
ELEV CONTROL
POWER/MANUAL
13
16
17
1
19
18

1. Gunner's selector switch box
2. Slip ring brush holder (5)
3. Power relay box
4. Powerpack
5. Powerpack pump motor
6. Pressure switch
7. Control box C2298/VRC (2)
8. Amplifier AM1780/VCR
9. Elevation selector valve
10. No. 1 man control handle
11. Elevating quadrant
12. Panoramic telescope
13. Direct fire telescope
14. Traverse mechanism bypass valve
15. Clutch valve solenoid
16. Dome lights (3)
17. NBC heater (4)
18. Air purifier
19. NBC control box

OVERALL ELECTRICAL SYSTEM BLOCK DIAGRAM, CAB (M109A2/M109A3)


1
2
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TO COLLIMATOR
CAB POWER
ELEV CONTROL
POWER/ MANUAL

1. Gunner's selector switch box
2. Slip ring brush holder (5)
3. Power relay box
4. Powerpack
5. Powerpack pump motor
6. Pressure switch
7. Control box C2298/VRC (2)
8. Amplifier AM1780/VCR
9. Elevation selector valve
10. No. 1 man control handle
11. Elevating quadrant
12. Panoramic telescope
13. Direct fire telescope
14. Traverse mechanism bypass valve
15. Traverse mechanism clutch
16. Dome lights (3)

1-9. EQUIPMENT LOCATION – Continued

j. Equilibrated elevating cylinder assembly

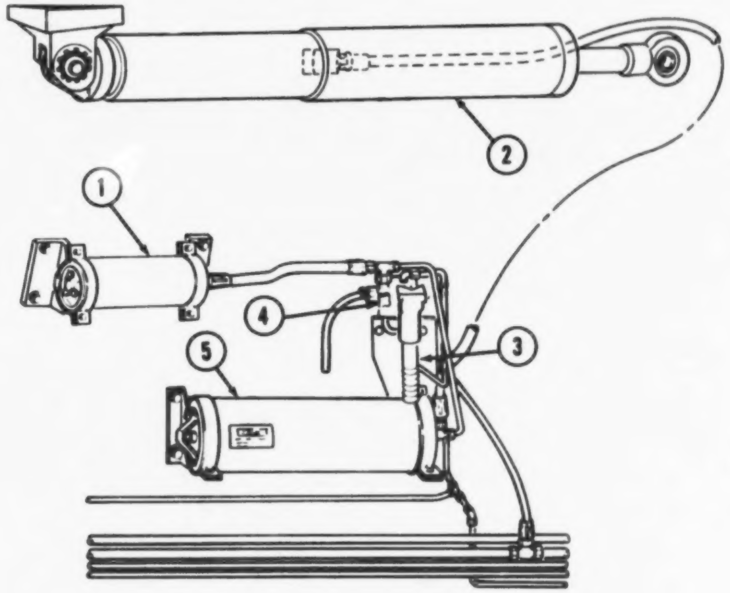
The howitzer has an equilibrated hydraulic elevating cylinder which will elevate, depress and balance cannon by applying a force equal and opposite to weapon unbalance force. Integral equilibration system acts hydropneumatically to exert preload on vehicle elevating system and permits cannon to be elevated or depressed with equal effort. Principle components of system are primary accumulator (5) and secondary accumulator (1), elevating cylinder (2), hand pump (3) and manifold (4).

1 Accumulators (primary and secondary)

Primary accumulator (5) and secondary accumulator (1) are cylinders containing hydraulic fluid and compressed nitrogen separated by a floating piston. Hydraulic fluid is forced through a tube from primary (5) and secondary (1) accumulators to equilibrated elevating cylinder by action of compressed nitrogen acting against floating piston.

2 Equilibrated elevating cylinder (2)

Rear end of equilibrated elevating cylinder (2) is attached to bracket on ceiling of cab by a pin and bearing. At forward end, piston rod is similarly attached to an arm of cradle (ref. page 1-10). Horizontal travel of piston causes rotation of cradle and cannon around trunnion.



Legend

1. Secondary accumulator
2. Equilibrated elevating cylinder
3. Hand pump
4. Manifold
5. Primary accumulator

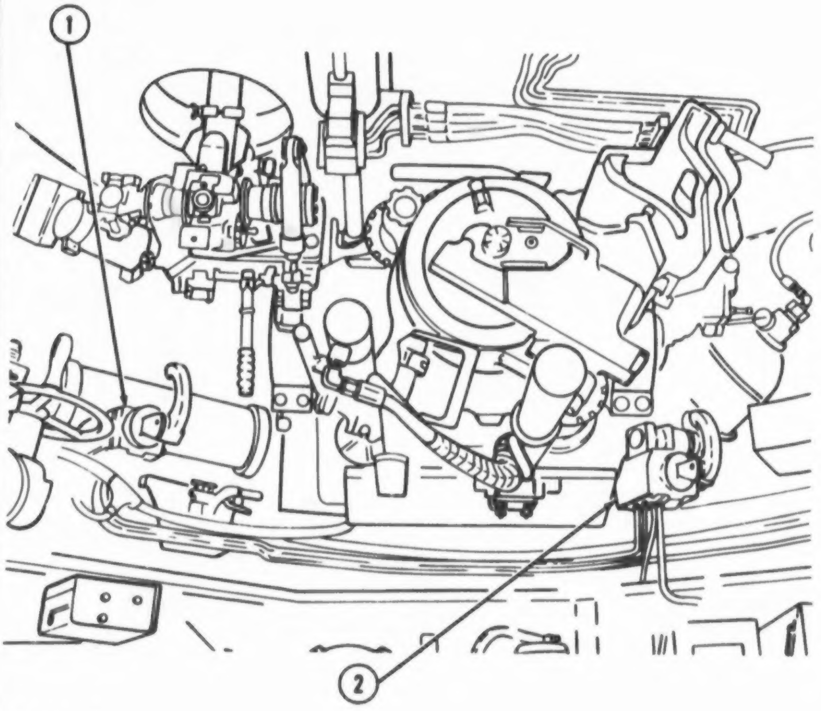
3 Hand pump

A hand pump (3) is incorporated into system to permit adjustment by increasing hydraulic fluid pressure. This permits equilibration system to be adjusted to compensate for variations in ground slope and temperature (ref. TM 9-2350-311-10).

4 Manifold

Manifold (4) controls flow of hydraulic fluid to equilibrated elevating cylinder (2).

1-9. EQUIPMENT LOCATION – Continued

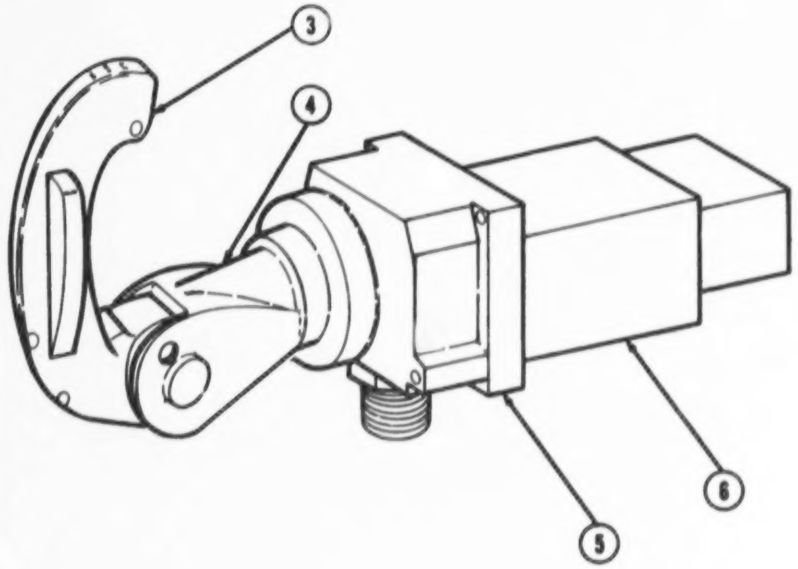


k. Gunner's control assemblies

Elevating and traversing system has gunner's control assembly and assistant gunner's control assembly. Gunner's control assembly (1) is located at left front of cab. Assistant gunner's control (No. 1 Man) (2) is located at the right front of cab.

Legend

1. Left control
2. Right control



Legend

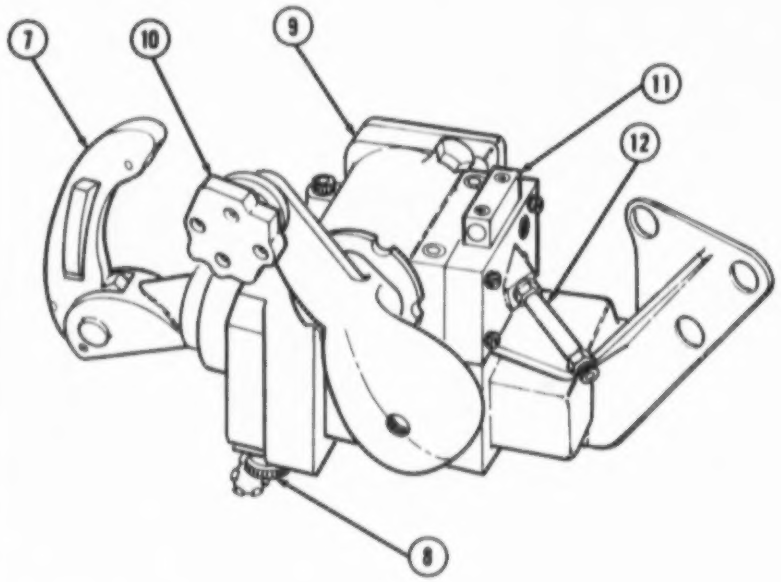
3. Handle
4. Handle bracket
5. Housing group
6. Valve body group

1 Gunner's control

Manual traversing can only be done at gunner's position with TRAVERSE CONTROL switch in manual position. To traverse with hydraulic power, top switch on gunner's selector switch box must be in power ON position. Middle switch for traverse control may be in power position. Tilting gunner's control handle (3) to one side or the other will cause cab to traverse in that direction under hydraulic power. To elevate hydraulicly, ELEVATION CONTROL switch must be in power position. Tilting gunner's control handle (3) backwards toward operator will then elevate cannon. Tilting gunner's control handle (3) forward will depress cannon hydraulicaly. Control assembly consist of handle (3) handle bracket (4), traversing cam, elevating rod, arm assembly spools, sleeves, centering springs and miscellaneous components enclosed in a housing group (5) and a valve body group(6).

INTRODUCTION – Section II. Equipment Description and Data–Continued

1-9. EQUIPMENT LOCATION – Continued



Legend

7. Handle
8. Cap
9. Manual elevating hand pump
10. Rotating handle
11. Shuttle valve
12. Check valve

k. Gunner's control assemblies-Continued

2 Assistant Gunner's control

Right control assembly operated by assistant gunner is used only to elevate and depress cannon. To operate with hydraulic power, ELEVATION CONTROL switch on gunner's selector switch box must be in No. 1 position. Tilting control handle (7) forward or backward will depress or elevate cannon in same manner as with gunner's control. The assistant gunner's control handle (7) cannot be used to traverse the cab, however, the traversing ports, (TL and TR), are closed with plugs and the inactive electrical receptacle is covered with a cap (8) on both control assemblies.

3 Manual elevating hand pump

Manual elevating hand pump (9) mounted on top of assistant gunner's control (7) is used to manually elevate or depress cannon. It is essentially a pistol type pump containing eight sliding pistons. By rotating handle (10) clockwise, fluid flow will be generated in manual elevating system, depressing cannon. By rotating handle (10) counterclockwise, fluid flow is reversed and cannon will be elevated. As rotating handle (10) is turned, an eccentric pump shaft is rotated, which in turn rotates a slide. As this slide rotates, it cams eight spring-loaded pistons in sequence so that fluid flow is initiated through manual elevating system. When direction of rotating handle (10) is reversed, integral slide rotates in opposite direction, reversing camming sequence and flow of fluid. Cannon may be elevated or depressed manually without energizing power control system. Rate at which cannon is elevated or depressed is controlled by speed of rotation of pump handle (10).

4 Shuttle valve

Shuttle valve (11), attached to top of hand pump manifold, controls pressure of manual circuit in case of hand pumping. Pump case is pressurized to keep handle (10) rotational effort at a minimum. Since low pressure will change to opposite sides of pump when handle (10) rotation is reversed, shuttle valve (11) will be shuttled to opposite side by high pressure of manual circuit and maintain low pressure in pump casing. Shuttle valve (11) will shuttle each time rotation of pump handle (10) is changed

5 Check valve

Manual elevating hydraulic system check valve (12) is a one-way valve that permits fluid to be directed from reservoir into manual elevating hydraulic system as required but will not permit fluid to return to reservoir.

INTRODUCTION — Section II. Equipment Description and Data—Continued

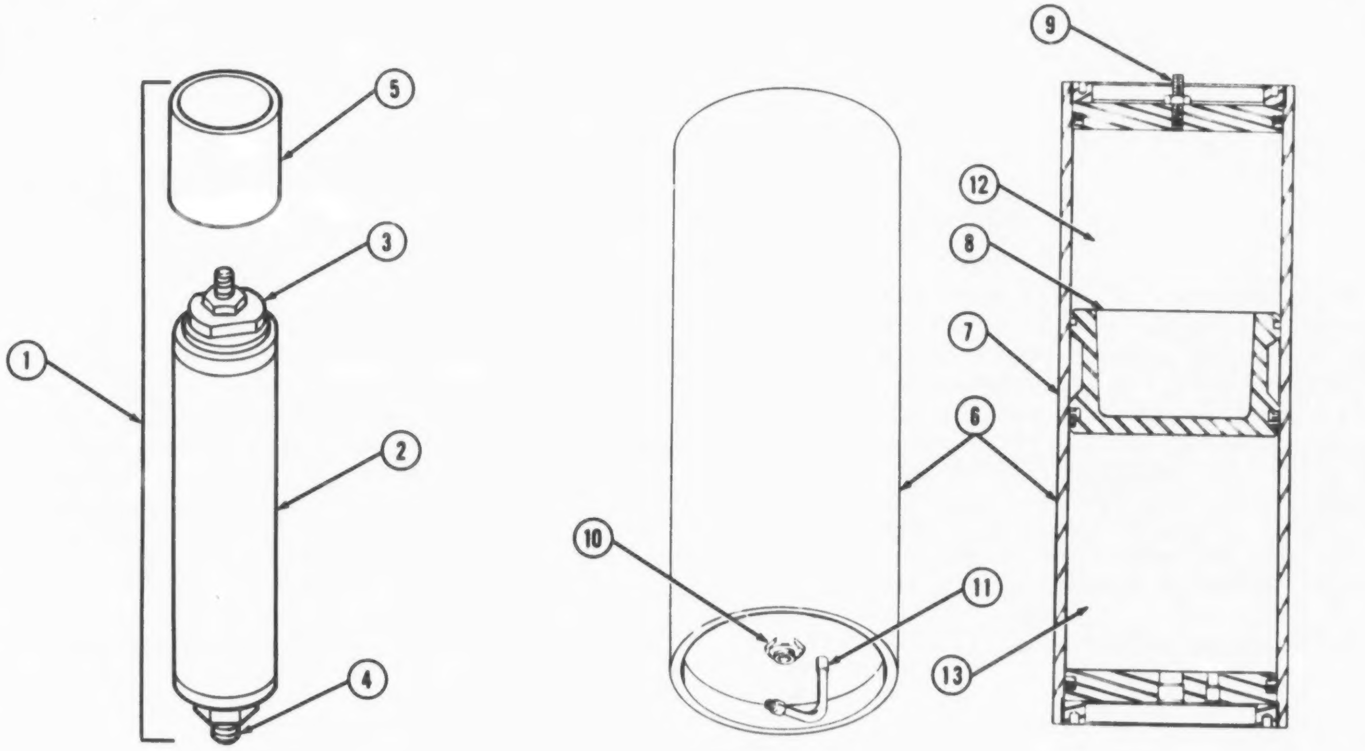
1-9. EQUIPMENT LOCATION — Continued

l. Manual elevating accumulator

Manual elevating accumulator (1) is mounted at right front side of trunnion support bracket above manual elevating hand pump. It maintains a minimum pressure on hydraulic fluid in manual elevating hydraulic system. It assures an immediate response in manual system when sudden demands for quantities of fluid cause excessive pressure drops. Manual elevating accumulator (1) consists of a cylinder (2) housing a floating piston. Top end of cylinder (2) contains a gas valve (3) while bottom end has a threaded port (4). Top of cylinder (2) is precharged with dry nitrogen (12) under pressure. This pressure is applied against hydraulic fluid (13) at bottom of cylinder (2). Dry nitrogen (12) and hydraulic fluid (13) are separated by floating piston . The manual elevating hydraulic system is charged by turning manual elevating hand pump handle counterclockwise until initial movement of elevating mechanism is detected. This will charge manual elevating accumulator with hydraulic fluid (13) under pressure. An end cap (5) covers gas valve (3).

m. Main accumulator

The main accumulator (6), mounted at right rear of cab, consists of a sealed cylinder (7) housing a floating piston (8). Top end of cylinder (7) contains a gas valve (9) while the bottom end has a central port (10) and a side port (11). Central port (10) at bottom end is connected to a relief valve and powerpack pressure regulator valve. Side port (11) is connected to a pressure gage and pressure switch. Top of cylinder (7) is precharged with dry nitrogen (12) under pressure. Pressure is applied against hydraulic fluid (13) at bottom of cylinder (7). Dry nitrogen (12) and hydraulic fluid (13) are separated by floating piston (8). Pressurized hydraulic fluid (13) is supplied to main accumulator (6) by a hydraulic pump located in powerpack reservoir.



Legend

1. Manual elevating accumulator
2. Cylinder
3. Gas valve
4. Threaded port
5. End cap
6. Main accumulator
7. Cylinder
8. Floating piston
9. Gas valve
10. Central port
11. Side port
12. Dry nitrogen
13. Hydraulic fluid

INTRODUCTION – Section II. Equipment Description and Data–Continued

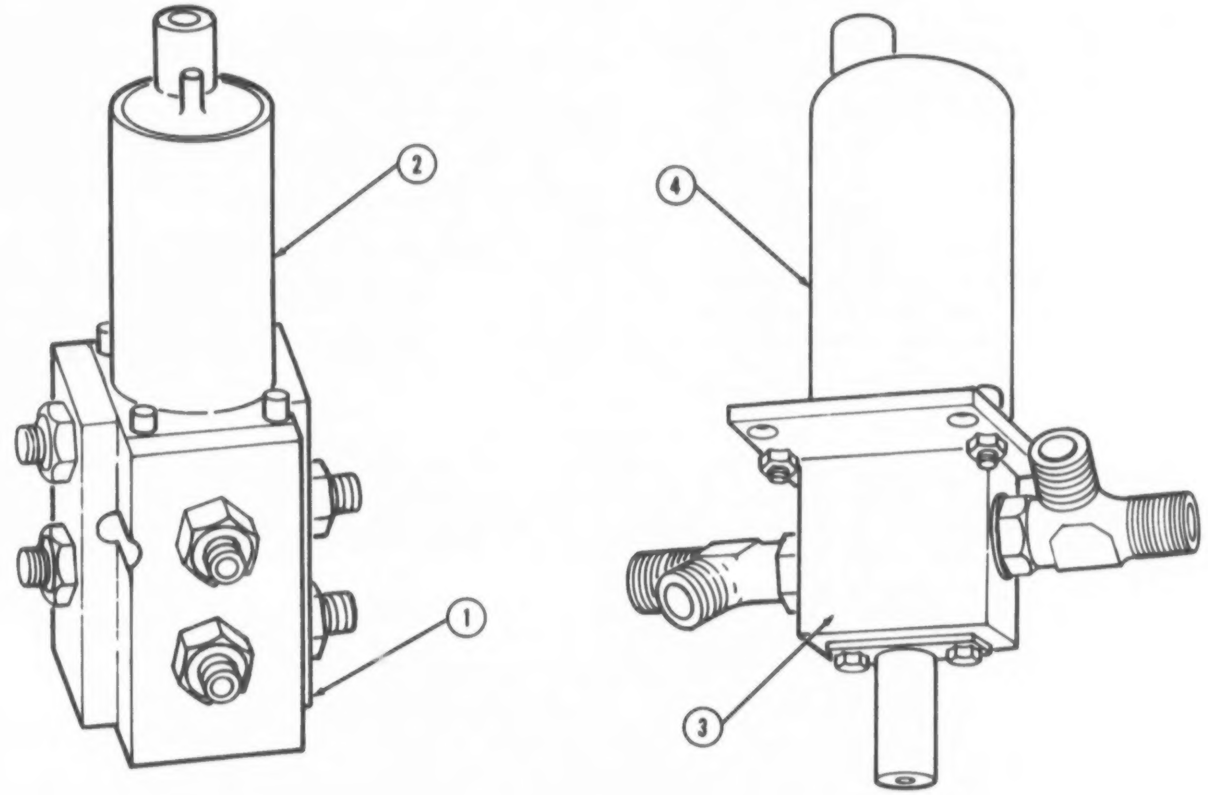
1-9. EQUIPMENT LOCATION – Continued

n. Elevation selector valve assembly

Elevation selector valve (1) is located at right front of cab, forward of manual elevation accumulator. It is actuated by a solenoid (2) energized by elevation control gunner's switch to determine which control (gunner's or assistant gunner's) regulates hydraulic fluid flow into elevation cylinder.

o. Traversing mechanism bypass valve

Traversing mechanism bypass valve (3) is located at left side of cab, forward of gunner's selector switch box. It is actuated by solenoid (4). When cab traversing mechanism is under manual control, traversing mechanism bypass valve (3) redirects hydraulic fluid flow so that it bypasses traversing mechanism hydraulic motor. During power operation, traversing mechanism bypass valve (3) closes and hydraulic motor drives traversing mechanism.



Legend

1. Elevation selector valve assembly
2. Solenoid
3. Traversing mechanism bypass valve
4. Solenoid

1-9. EQUIPMENT LOCATION – Continued

p. Powerpack

Powerpack mounted at right rear of cab, provides a supply of hydraulic fluid at a constant pressure for control and actuation of elevating, traversing and ramming systems. It consists of a reservoir assembly, electric drive motor (4), pressure regulator valve (6), power valve (7), internal filter (3) or two external filters (3.1), and fluid level gage (5).

1 Reservoir assembly

The reservoir assembly in M109A2/M109A3 howitzers consists of a reservoir (1), hydraulic pump (2), internal filter (3), strainer and fluid level gage (5). (M109A4 howitzers have replaced the internal filter with two external filters (3.1).) Purpose of the reservoir (1) is to supply hydraulic fluid to gear-type hydraulic pump (2) and retain any hydraulic fluid that is not being used by system. At base of reservoir (1) is an electric drive motor (4), prime source of power for the system.

2 Electric drive motor

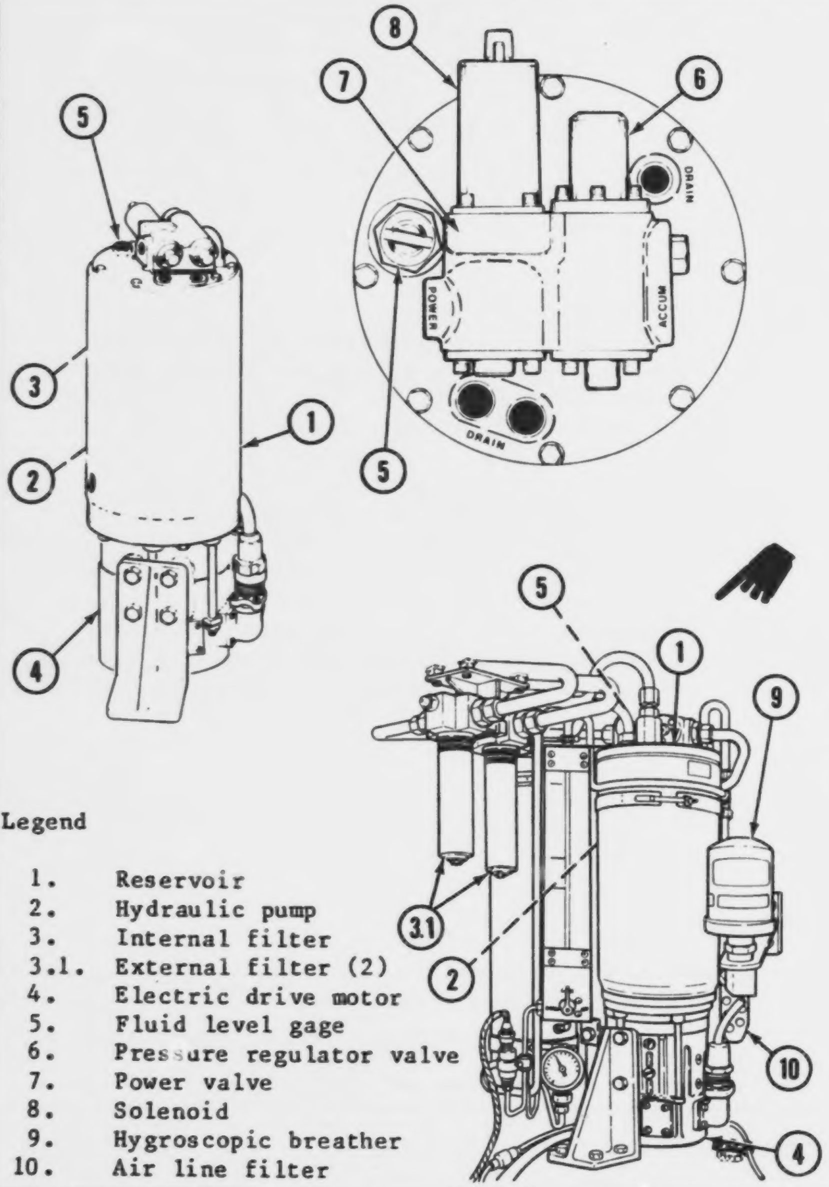
The electric drive motor (4) is a 5-horsepower, compound-wound, waterproof, fully enclosed, sealed motor. Through a coupling, it drives hydraulic pump (2). ON and OFF operation of electrical drive motor (4) is controlled by main accumulator pressure switch and hydraulic pump motor relay.

3 Pressure regulator valve

The pressure regulator valve (6) keeps operating fluid pressure at a constant level. For a given input handle position, a system output will be maintained at a constant speed.

4 Power valve

The power valve (7) provides operating pressure for elevating, traversing and ramming systems. The power valve (7), operated by a solenoid (8) is activated when CAB POWER switch is placed in ON position.



Legend

1. Reservoir
2. Hydraulic pump
3. Internal filter
3.1. External filter (2)
4. Electric drive motor
5. Fluid level gage
6. Pressure regulator valve
7. Power valve
8. Solenoid
9. Hygroscopic breather
10. Air line filter

5 Filter

The internal filter (3) on M109A2/M109A3 howitzers connects top of hydraulic pump (2) (hidden) to cover of reservoir (1). The two external filters (3.1) on M109A4 howitzers connect to the drain and pressure lines coming from the powerpack. The filter(s) prevents foreign particles, which may be present in reservoir fluid supply, from entering valve system.

6 Fluid level gage

The fluid level gage (5) is located on cover of reservoir (1) within strainer. It consists of a filler cap, breather and dipstick. It is used for measuring and filling reservoir (1) with hydraulic fluid. Strainer is an additional filter to filter out foreign matter from fluid being added to reservoir (1).

7 Hygroscopic breather and air line filter (M109A4 only)

The hygroscopic breather (9) and air line filter (10) are located at the bottom of a powerpack drain line. They filter accumulated air and condensation trapped in the hydraulic system due to oil temperature fluctuations and exposure during maintenance.

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INTRODUCTION – Section II. Equipment Description and Data–Continued

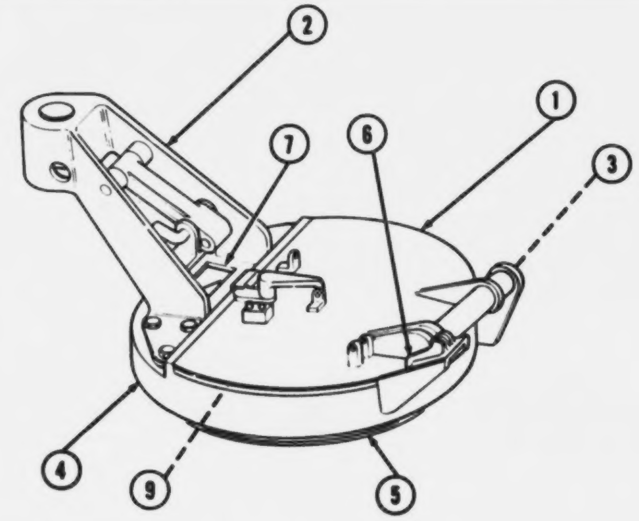
1-9. EQUIPMENT LOCATION – Continued

q. Commander's cupola

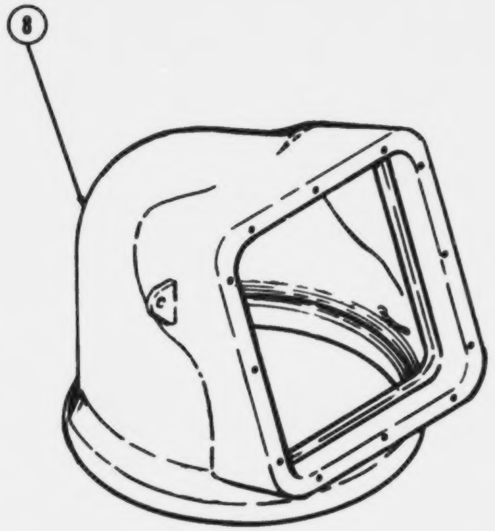
Hatch cover (1) of the commander's cupola is hinged on side opposite the machinegun support assembly (2) and counterbalanced with a torsion bar (3) for ease of opening. A spring loaded latch (6) holds hatch cover (1) in full open position, a positive lock in closed position. Cupola body assembly (4) is supported by a mechanism of race rings (5) and ball bearings to permit easy 360° manual traverse. A spring-loaded latch (9) can lock commander's cupola in traverse at intervals of 30° around the circle. A periscope slot (7) at front of commander's cupola permits mounting of a periscope for observation by commander.

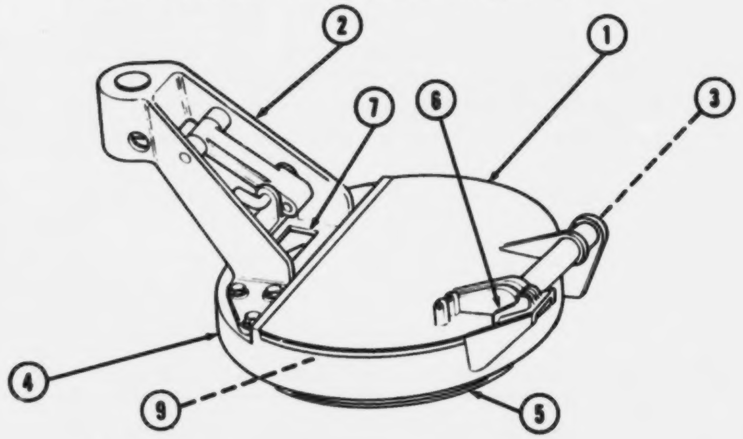
r. Panoramic telescope cover

The purpose of the panoramic telescope cover (8) is to prevent muzzle blast from entering crew compartment and to protect gunner and telescope from inclement weather and small arms fire. Panoramic telescope cover (8) is mounted on race rings and ball bearings to give 360° traverse. It can be locked in any position by two setscrews or rotated manually by two webbing straps. Traverse of panoramic telescope cover (8) is independent of telescope.



EARLY DESIGN COMMANDER'S CUPOLA
WITH OUTSIDE LATCH (SOME M109A3'S)





LATER DESIGN COMMANDER'S CUPOLA
WITHOUT OUTSIDE LATCH (ALL M109A2'S,
AND SOME M109A3'S)

Legend

1. Hatch cover
2. Machinegun support assembly
3. Torsion bar
4. Cupola body assembly
5. Race rings
6. Spring loaded latch
7. Periscope slot
8. Panoramic telescope cover
9. Spring-loaded latch (rotation)

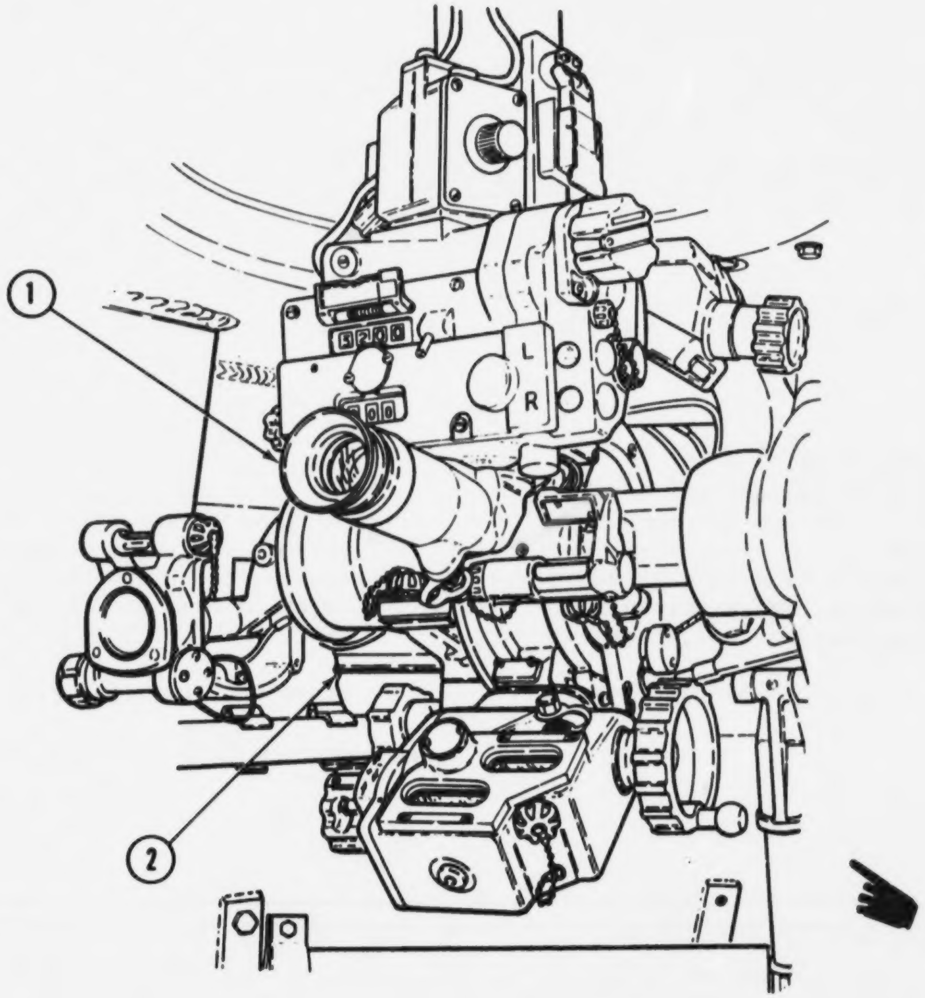
1-9. EQUIPMENT LOCATION – Continued

s. Overall sighting and fire control system

Howitzer is provided with a sighting and fire control system capable of delivering direct or indirect fire. Location and description of the specific equipment is as follows:

1 Panoramic telescope M117/M117A2 and telescope mount M145

These are mounted at the gunner's position and are used for indirect fire. The telescope mount M145 (2) provides adjustable base with azimuth and elevation controls. It holds the panoramic telescope M117/M117A2 (1) sight in position. Head of scope sights through the panoramic telescope cover on top of cab. For information on panoramic telescope M117/M117A2 refer to TM 9-1240-274-34 and telescope mount M145 refer to TM 9-1240-273-34.



Legend

1. Panoramic telescope M117/M117A2
2. Telescope mount M145

1-9. EQUIPMENT LOCATION – Continued

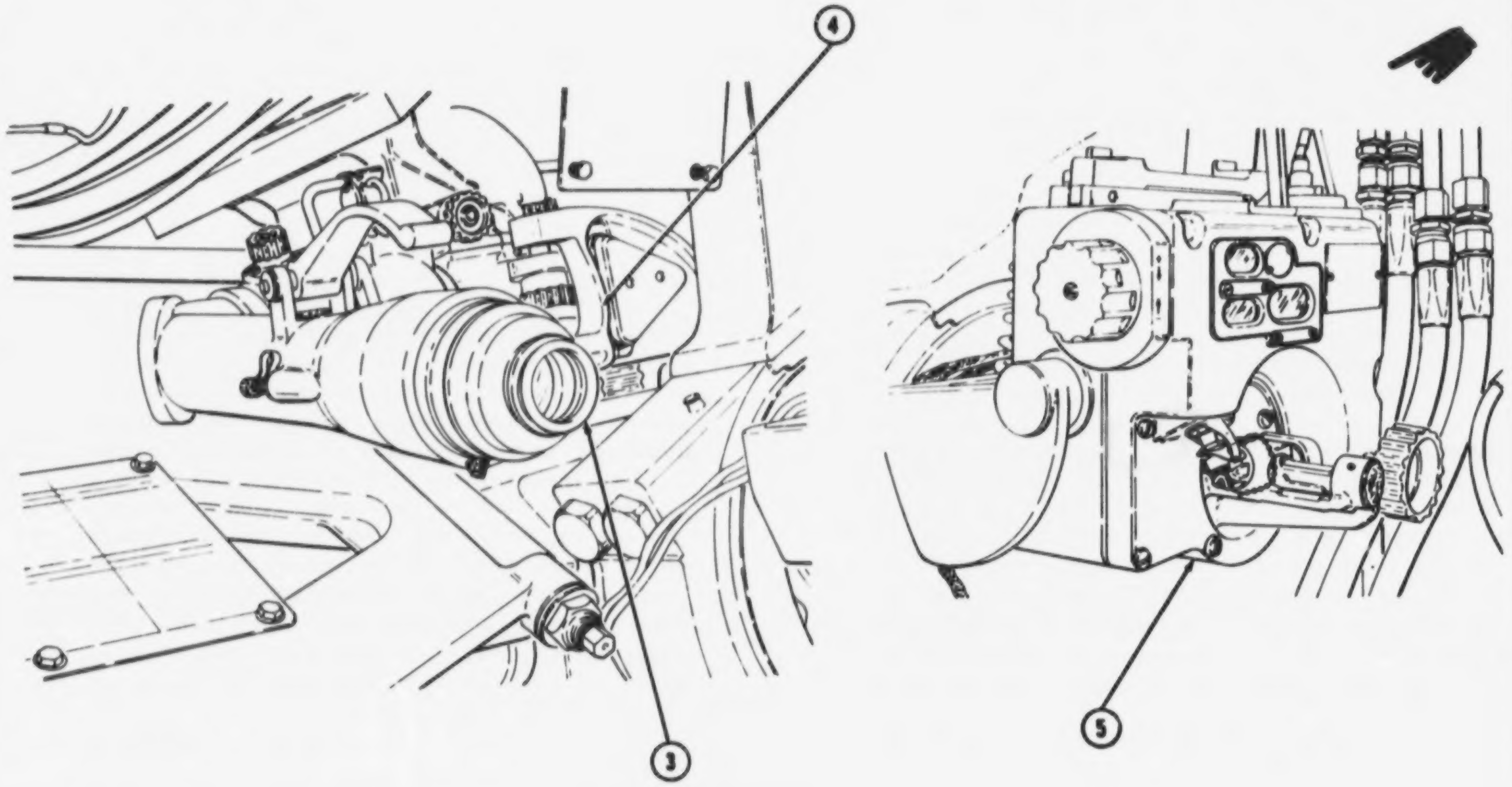
s. Overall sighting and fire control system-Continued

2 Elbow telescope M118A2 and telescope mount M146

This equipment is mounted at No. 1 man's position. It sights through an aperture on right side of the cannon tube. It is used for direct fire. The telescope mount M146 (4) provides a base that can be adjusted. It holds the elbow telescope M118A2 (3). For information on elbow telescope M118A2 (3) refer to TM 9-1240-276-34 and telescope mount M146 (4) refer to TM 9-1240-275-34.

3 Elevation quadrant M15

The elevation quadrant M15 (5) is mounted on trunnion at No. 1 man's position. It gives an accurate, direct reading of the gun elevation. It is used for a cross check against the other equipment. For further information on elevation quadrant M15 (5) refer to TM 9-1290-322-35.



Legend

3. Elbow telescope M118A2
4. Telescope mount M146
5. Elevation quadrant M15

INTRODUCTION – Section II. Equipment Description and Data–Continued

1-9. EQUIPMENT LOCATION – Continued

s. Overall sighting and fire control system-Continued

4 Alinement device M140

Alinement device M140 (6) is used to aline or to check alinement of sighting equipment when positioned on a bracket next to cannon tube. Elbow telescope M118A2 sights thru the alinement device M140 (6) permitting check of crosshair positions. When mounted on hull bracket, panoramic telescope M117/M117A2 sights thru alinement device M140 (6) to check crosshair alinement. The alinement device M140 (6) is radioactively illuminated. Check for presence of illumination in a low light environment. If illumination is not present, notify radiological protection officer. Do not attempt to repair. For information on DS/GS repairs of the alinement device M140 (6) refer to TM 9-4931-710-14&P.

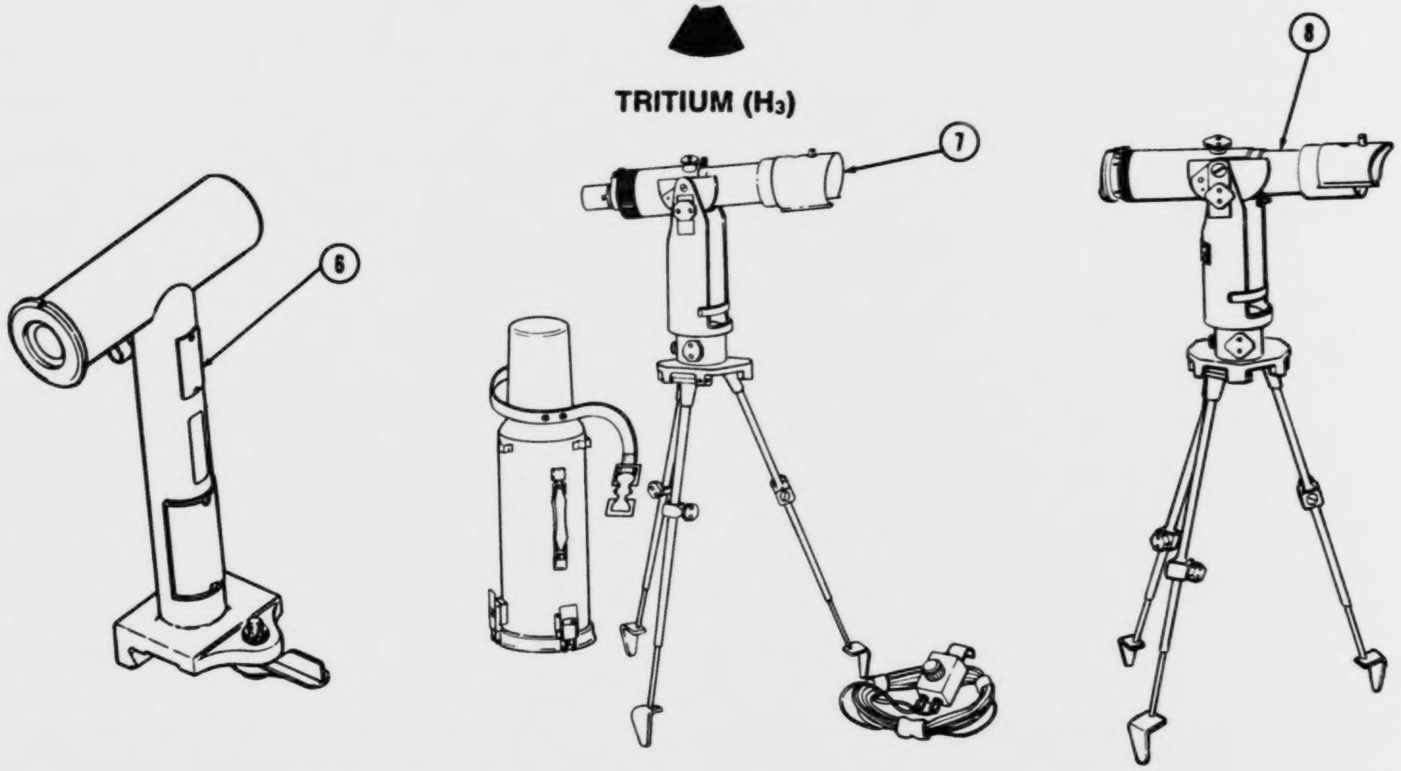
5 Infinity aiming collimator M1/M1A1

When in use, the M1 (7) and M1A1 (8) collimators are mounted on a tripod a short distance from vehicle. Their illuminated reticles provide a fixed reference point to correct sighting after a round has been fired. Power for illumination of infinity aiming collimator M1 (7) comes thru a cable from gunner's control box. The infinity aiming collimator M1A1 (8) is radioactively illuminated. Check for presence of illumination in a low light environment. If illumination is not present, notify radiological protection officer. Do not attempt to repair. For further information on infinity aiming collimators M1/M1A1 (7 and 8) refer to TM 9-1240-324-34.

WARNING

RADIATION HAZARD

TRITIUM (H_3)



Legend

6. Alinement device M140
7. Infinity aiming collimator M1
8. Infinity aiming collimator M1A1

INTRODUCTION – Section II. Equipment Description and Data–Continued

1-10. EQUIPMENT DATA

Tabulated data concerning the cannon M185, mount M178, equilibrated system, rammer and equilibrated elevating cylinder can be found below. This is supplemental to data contained in TM 9-2350-311-20-2.

a. Cannon M185

Bore diameter	155MM
Center of gravity of tube (forward from rear face of tube)	93.87 in. (238 cm)
Center of gravity of cannon (complete from rear face of breech ring)	98.12 in. (249 cm)
Length:	
Tube	238.5 in. (605 cm)
Cannon	271.38 in. (689 cm)
Weight:	
Tube	3166 lb (1437 Kg)
Muzzle brake	350 lb (158 Kg)
Evacuator chamber (approx)	75 lb (34 Kg)
Cannon (complete)	4185 lb (1898 Kg)
Rifling:	
Length	199.15 in. (506 cm)
Depth of groove	0.05 in. (0.127 cm)
Width of lands	0.15 in. (0.381 cm)
Number of grooves	48
Twist	Uniform right hand: one turn in 20 calibers
Type of breech mechanism	Semiautomatic screw block
Type of firing mechanism	Continuous pull percussion
Effective range	18,000 meters
Tube life	Ref. TM 9-1000-202-14
Ammunition	Separate loading (ref. TM 9-2350-311-10) for authorized ammunition

b. Mount M178

Weight of cradle assembly	1200 lb (544.32 Kg)
Length of mount (minus howitzer dust shield)(approx.)	48-3/4 in. (124 cm)
Overall height of mount (with rotors) (approx.)	37 in. (94 cm)
Overall width of mount (approx.)	43 in. (109 cm)
Elevation (max)	+1333 mils
Depression (max)	-53 mils
Variable recoil assembly:	
Length of recoil (from -53 mils to +906 mils elevation)	36 in. (91 cm)
Length of recoil (+1333 mils elevation)	24 in. (61 cm)
Preload on recuperator (nitrogen pressure)	700 psi (4827 kPa)
Preload on replenisher accumulator:	
Nitrogen pressure	7-8 psi (48-49 kPa)
Hydraulic fluid MIL-H-6083 (Item 11, App. C) pressure	17-24 psi (117-165 kPa)

c. Equilibration system

Preload in accumulators	
Nitrogen pressure:	
Primary	900 psi (6205 kPa)
Secondary	1500 psi (10,342 kPa)

INTRODUCTION — Section II. Equipment Description and Data—Continued

1-10. EQUIPMENT DATA — Continued

d. Equilibrated elevating cylinder and rammer

Hydraulic pressure source	Cab power hydraulic system
Regulated system hydraulic pressure available	875 to 950 psi (6033-6550 kPa)

e. Cab traversing mechanism

Traverse of cab	360 degrees (6400 mils)

Hydraulic motor:

Estimated displacement per revolution	0.687 cu in. (11.26 cc)
Maximum speed	4800 rpm
Maximum operating speed	3600 rpm

f. Manual elevating accumulator

Capacity, hydraulic oil	10 cu in. (163.9 cc)

g. Main accumulator

Type: Floating piston

h. Powerpack (complete)

Capacity, hydraulic oil	11.25 qt (10.65 L)

Electric drive motor:

Rated speed (full load)	3800 rpm
Rated power	5 hp
Rotation (as viewed from drive end)	clockwise

1-11. DIFFERENCES BETWEEN MODELS

All M109A2 vehicles are similar to each other. Variations exist in the M109A3 population, as a result of work done under the program to convert M109A1 vehicles to M109A3 configuration. Additionally, some M109A2 and M109A3 models have been converted to M109A4 models.

There are 103 parts which are peculiar to M109A3 vehicle population. Maintenance procedures in this manual will call technician's attention to any differences in cab components which will affect technician's performance of direct and general support maintenance tasks. Where parts which may be removed or inspected differ significantly in appearance, a cutaway view will be used to show alternate parts. Part differences not relevant to direct or general support technician will not be mentioned or depicted.

Where differences in vehicle population exist, the manual will not state whether differences are among M109A3 cabs or between M109A2, M109A3, and M109A4 cabs. Typically, a difference between models will be described in this manner. "Some vehicles have three contact arm assemblies and some have five contact arm assemblies."

Cab component differences important to the direct or general support technician are listed below:

FUNCTIONAL GROUP NO.	CHAPTER	PART NAME	NUMBER OF VARIATIONS	DESCRIPTIONS OF DIFFERENCES
00	3	Protective shields	2	All production M109A2 vehicles use five shields. All production M109A3 vehicles use four shields.
01	3	Race rings	2	Some vehicles have 212 ball bearings mounted on 106 separators. Other vehicles have 213 ball bearings mounted on helical compression springs.
02	4	Variable recoil actuator follower	2	Early production M109A3 vehicles use eyebolts, with separate tension adjustment hex nuts. Later production M109A3 and all M109A2 vehicles use eyebolts with integral tension adjustment hex nuts.

1-11. DIFFERENCES BETWEEN MODELS – Continued

FUNCTIONAL GROUP NO.	CHAPTER	PART NAME	NUMBER OF VARIATIONS	DESCRIPTIONS OF DIFFERENCES
02	4	Variable recoil actuator assembly	2	Early production M109A3 vehicles mount cam lever on a shaft and ball bearings. Later production M109A3 and all M109A2 vehicles mount cam lever on a shouldered bolt and roller.
03	5	Hydraulic manifold, manual elevating pump	2	Early production M109A3 vehicles have manifold with integral check valves. Later production M109A3 and all M109A2 vehicles have manifolds tapped and threaded to connect to separate check valves.
03	5	Hydraulic powerpack	2	M109A4 vehicles have replaced M109A2/M109A3 internal powerpack filter with two externally located filter assemblies (ref. page 1-33).
03	5	Hydraulic power pack electric motor	2	Two different types of motor are used on vehicles. The different types of motor are interchangeable, but individual parts are not interchangeable between motors.

06	7	Electrical contact segment ring and arm	2	There are two variations of mounting hardware. Some have covered rings and arms. Other vehicles do not.
09	9	Traversing mechanism	2	M109A4 vehicles have modified traversing mechanisms. The electric clutch has been replaced by a hydraulic clutch, the brush assembly has been eliminated and a clutch valve replaces it, and a different handwheel is used.
10	10	Cover assembly, commander's cupola	2	Early production M109A3 vehicles have cover with outside locking hatch. Later production M109A3 vehicles and all M109A2 vehicles have no outside latch.

CHAPTER 2 GENERAL CAB MAINTENANCE

GENERAL

This chapter contains information on repair parts, tools, inspection procedures, general maintenance practices and troubleshooting. All information in this chapter is presented for implementation by direct and general support maintenance shops.

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GENERAL CAB MAINTENANCE — Section I. Repair Parts, Special Tools and Support Equipment

2-1. SCOPE

This chapter contains general maintenance, inspection and repair data for cab, armament, elevating and traversing systems and associated components used on 155MM self-propelled howitzers. Expendable supplies normally required in performing maintenance and repair operations are listed in Appendix C.

Section I provides guidelines on the use of tools and repair parts. Tools, equipment and repair parts are issued to supporting maintenance units for maintaining and repairing the materiel. Tools and equipment should not be used for purposes other than those prescribed and, when not in use, should be properly stowed in chest and/or roll provided.

2-2. COMMON TOOLS AND EQUIPMENT

Standard and commonly used tools and equipment having general application to this materiel are authorized for issue by Tables of Allowances (TA) and Tables of Organization and Equipment (TOE) listed in SC4933-95- CL-A12, SC4933-95-CL-A10, SC4933-95-CL-E19, and SC5180-95-CL-A12.

2-3. SPECIAL TOOLS AND SUPPORT EQUIPMENT

Tools and equipment specially designed for supporting maintenance are tabulated in Appendix B. The list in Appendix B is not to be used for requisitioning replacements. Special tools and equipment are listed in TM 9-2350-311-34P-2, which is the authority for requisitioning replacements for supporting maintenance.

2-4. REPAIR PARTS

Repair parts are listed and illustrated in TM 9-2350-311-34P-2. The parts listed in the RPSTL are used in ordering repair parts and special tools for direct support and general support maintenance of the howitzer cab.

It is important that careful troubleshooting be used to determine what parts are to be replaced before the component is disassembled for repair.

For replacement of seals, packings, gaskets, etc. in certain component assemblies, refer to TM 9-2350- 311-34P-2 for the following authorized repair kits:

GENERAL CAB MAINTENANCE – Section I. Repair Parts, Special Tools and Support Equipment – Continued

2-4. REPAIR PARTS – Continued

Component:

- Elevating cylinder valves and and bracket (locking valve)
- Equilibrated elevating cylinder
- Manual elevation handle and pump assembly (hydraulic pump)
- Powerpack accumulator assembly (accumulator)
- Rammer cylinder assembly
- Variable recoil assemblies
- Variable recoil recuperator matched heads
- Counter recoil buffer assembly (buffer cylinder)
- Powerpack reservoir cover assembly (power valve)
- Traversing mechanism hydraulic motor assembly (hydraulic motor) (lubricating pump)
- Lower housing drive shaft, driven gear shaft drive gear and bearings (shim set)
- Variable recoil actuator assembly (shim set)

2-5. FABRICATED TOOLS

Appendix E illustrates fabricated tools which direct support and general support maintenance shops can make locally if they so desire. The fabricated tools are helpful to organizations which repair a number of identical components.

NOTE

Fabricated tools are not available for issue.

2-6. GENERAL INSPECTION AND TYPES OF INSPECTION

a. Introduction

Inspections are made for the purpose of determining condition of an item as to serviceability, recognizing conditions that would cause failure and assuring proper application of maintenance policies at prescribed levels.

NOTE

Make sure that identification markings on major assemblies correspond to those entered in weapon record book.

b. General Procedures

Initial inspection information is included to aid maintenance personnel in determining cause of unserviceability, extent of repairs and an estimate of replacement parts needed. In the event materiel is received in a maintenance shop for repair without complete information regarding deficiencies, perform a complete maintenance shop inspection to determine required parts. More common malfunctions, with probable causes and corrective actions, are given in Troubleshooting (ref. pages 2-20 thru 2-75). Malfunctions which can be diagnosed and/or corrected by crew or organizational maintenance personnel are provided in TM 9-2350-311-10 and TM 9-2350-311-20-2.

1 Maintenance Shop Inspection (ref. AR-750-51).

2 Inspections made while components are mounted in vehicle are, for the most part, visual and are to be performed before attempting to operate these components. The purpose of these inspections is to determine condition of materiel, and if found not operating efficiently, to take precautions to prevent any further damage.

3 For troubleshooting performed while materiel is mounted in vehicle and which is beyond scope of the using unit refer to TM 9-2350-311-30-2. Then proceed as outlined in this section.

4 Inspection after materiel is removed from vehicle is performed to verify diagnosis made while installed and to uncover further defects.

5 Standard armament theories and principles of operation apply in troubleshooting materiel. The greater number of symptoms of troubles that can be calculated, the easier will be isolation of defect.

2-6. GENERAL INSPECTION AND TYPES OF INSPECTION – Continued

6 The troubleshooting procedures beginning with page 2-20 are for supporting maintenance and are supplemental to troubleshooting procedures outlined in TM 9-2350-311-20-2.

7 In-process inspection instructions on materiel are contained at end of each repair chapter together with applicable repair instructions.

8 Final inspection instructions for materiel in supporting maintenance shops are contained on page 2-9.

9 Hydraulic system inspection tests on components and system can only be checked with elevating, traversing systems and rammer valve completely installed in vehicle. Refer to TM 9-2350-311-20-2 for checkout procedure of system and external leakage allowance criteria for components.

10 Pre-embarkation inspection (DS/GS category) is to determine whether preventive maintenance has been performed. It is critical that equipment in units alerted for overseas movement be in good working order.

11 Inspection of materiel in the hands of the troops is performed after pre-embarkation inspection and is part of the preparation for overseas movement. DS/GS performs this inspection (ref. page 2-11).

2-7. INSPECTION AND REPAIR DATA AND GENERAL INSPECTION GUIDELINES

a. Inspection and repair data are included with exploded view illustrations in Chapters 3 thru 13.

Inspection and repair tabulated data give inspection requirements. Wear limits are listed which indicate the point to which parts may be worn before replacement. Normally all parts which have not been worn beyond dimensions given in the "Wear limit" column or damaged by corrosion will be approved for service.

b. General Inspection Guidelines

1 Inspect cast parts for cracks or fractures and inspect interiors for scores and burrs.

NOTE

Inspection of sleeves is to be accomplished without removing sleeves from valve bodies. Use a small mirror and pencil-type flashlight. Spools and sleeves are non-interchangeable. If one is rejected, also reject its mating part.

2 Inspect pistons, spools and sleeves, checking to see that bores and parts are clean and free of foreign matter and burrs.

3 Inspect ball bearings.

a Inspect all bearings in accordance with TM 9-214.

b Inspect ball check valves for cracks, fractures, signs of galling, pitting or corrosion. Take several measurements of the diameter of each ball to check for roundness and proper diameter. Replace ball if damaged.

c Perform maintenance functions on bearings in accordance with TM 9-214.

4 Inspect bushing-type bearings.

NOTE

- Inspection of bearings is to be accomplished without removal of bearing. Use a small mirror or pencil-type flashlight when necessary.

CAUTION

Never scribe-mark bearing surfaces.

- Observe position of defective bearing within housing so that new bearing may be replaced in a similar manner.

a Inspect bearing for cracks, fractures, signs of galling, pitting, scoring or corrosion.

b Replace bearing if damaged.

5 Non-metallic seals, gaskets and preformed packings are not to be inspected or evaluated. Replace all seals, gaskets and preformed packings.

6 Inspect gears.

a Inspect gears for wear, nicks, flaking, scoring and burring. Check gears that have been shrunk or pressed with component parts.

b Remove minor nicks with a fine stone or crocus cloth that has been dipped in dry cleaning solvent PD 680 (Item 7 App. C). Replace gears if teeth are damaged.

2-7. INSPECTION AND REPAIR DATA AND GENERAL INSPECTION GUIDELINES

7 Inspect splined parts.

- a Inspect splines and shafts for cracks, fractures, scores and deformation.
- b Replace any splined part if splines do not permit secure fit.
- c Replace shafts if cracked, fractured, scored or deformed.

8 Inspect threaded parts. Inspect all screws, bolts, nuts, studs and threaded holes for worn or damaged threads.

9 Inspect snap rings.

- a Inspect snap rings for damage that would impair use.
- b Replace snap rings if damaged.

10 Inspect soldered joints for defects.

- a Inspect soldered components for cold joints. If soldered component or wire lead is mobile, desolder and solder the joint again (ref. TM 9-2350-311-20-2 and TB SIG 222).
- b Inspect soldered electrical components for solder bridges. Desolder and resolder to eliminate bridges (ref. TM 9-2350-311-20-2).

11 Inspect welds. Inspect all weldments for broken or defective welds.

12 Inspect finishes and plated surfaces.

- a Inspect all painted surfaces. Repaint surfaces where required.
- b Inspect plated surfaces for signs of flaking, wear or deterioration of plating.
- c Remove old plating, if necessary. Replace according to standard shop practice.

13 Inspect for emulsified fluids. Emulsified fluid in hydraulic systems, characterized by milky color, can result from air becoming trapped in the fluid or from nitrogen leaking past piston seals. If milky hydraulic fluid is observed, drain, purge and refill hydraulic system. Observe hydraulic fluid again after several days. If hydraulic fluid is again emulsified, repair defective cylinder.

2-8. FINAL INSPECTION

a. General

Final inspection is performed after repair has been completed to insure that cab, howitzer, cannon mount, elevating and traversing systems, rammer and all components are in serviceable condition before returning to user. All materiel will meet performance and serviceability requirements of this section prior to acceptance for delivery.

b. Procedure

1 Check all painted surfaces for conformance to the standards of TM 9-213.

2 Insure that all unpainted surfaces are lightly coated with grease, automotive and artillery (Item 9, App. C).

3 Inspect nuts, bolts, screws, pins and fastening devices for security of installation.

4 Observe rotating parts in motion to determine smooth operation without excessive play and/or bind.

5 Test operation of exterior spring-loaded devices to insure proper spring compression.

6 Inspect locations of gaskets, seals, wipers, ports and packings for evidence of leakage (refer to applicable test procedure).

7 Inspect hydraulic tubes, fittings and components for leakage. Exercise hydraulic components (ref. TM 9-2350-311-10).

8 Check for proper nitrogen pressure in recuperator and elevating and traversing systems (refer to applicable test procedure).

9 Examine canvas items for tears or deterioration.

10 Make sure a detailed inspection of repaired systems and components, as described above in the paragraph on General Inspection, has been performed.

11 Check level of howitzer cannon trunnions and gun travel lock alinement (TM 9-2350-311-20-2).

c. Repair Parts and Equipment

All repair parts and equipment must be complete or requisitions initiated for procurement of damaged, missing or unserviceable parts.

d. Lubrication

Lubrication must be complete and in accordance with LO 9-2350-311-12.

2-9. DS/GS PRE-EMBARKATION INSPECTION FOR OVERSEAS ALERT

a. Prior to inspection of materiel in hands of troops preparatory to oversea movement, make a general inspection to determine whether preventive maintenance has been performed. Report neglect of maintenance to higher authority.

b. The howitzer cannon M185 and mount M178, either in the hands of troops alerted for oversea movement, or supporting maintenance shops being processed for oversea shipment, must conform to standards as set forth herein. All replacement materiel issued from storage or withdrawn from higher levels of maintenance expressly for replacement of like serviceable materiel will conform in detail to standards of overhauled materiel.

c. Inspect all components and assemblies. Inspect for smooth operation and satisfactory performance. Replace all incomplete or unserviceable components or assemblies. Inspect all screws and locking devices for secure installation.

d. Paint on materiel must be of regulation color and luster and must cover all specified surfaces thoroughly and sufficiently in order to prevent corrosion.

e. Inspect all points of lubrication for compliance with LO 9-2350-311-12.

f. Inspect all unpainted metal surfaces and coat with film of medium preservative lubricating oil. This coating of oil is only a protection until materiel is processed for shipment.

g. The vehicle must be accompanied by complete sets or organizational spare parts and equipment as normally issued with the vehicle, when shipped overseas.

h. Inspect all accessories, tools and spare parts for serviceability and completeness. All defective items must be replaced. It normally is not necessary to inspect items in sealed packages since they have been inspected for serviceability prior to packaging and during storage.

i. Perform inspections as prescribed for inspection of materiel in the hands of troops outlined (ref. page 2-11).

2-10. INSPECTION OF MATERIEL IN THE HANDS OF TROOPS

WARNING

Before starting an inspection on armament, be sure to clear weapon. Do not actuate firing mechanism until weapon has been cleared. Inspect chamber to insure that it is empty and no ammunition is in position to be introduced. Avoid having live ammunition in vicinity of work area. Serious injury or death could result to personnel.

a. Refer to AR 750-8 for responsibilities and fundamental duties of inspecting personnel, and necessary notice and preparations to be made, forms to be used general procedures and methods to be followed by inspectors.

b. Inspector will accomplish the following:

1 Determine serviceability, i.e., degree of serviceability, completeness, and readiness for immediate use, with special reference to safe and proper functioning of the materiel. If materiel is found unserviceable or incipient failures are disclosed, deficiencies will be corrected on the spot or advice given as to corrective measures when applicable, or, if necessary, materiel will be tagged for delivery to, and repaired by maintenance personnel.

2 Determine cause of mechanical and functional difficulties that troops may be experiencing and check for apparent results of lack of knowledge, misinformation, neglect, improper handling and storage, security, and preservation.

3 Inspect to see that all authorized modifications have been applied, that no unauthorized alterations have been made, and that no work beyond the authorized scope of unit is being attempted. Check index in DA PAM 310-2 and the current MWO files for any MWO's printed after this publication.

4 Instruct using personnel in proper preventive maintenance procedures where found inadequate.

5 Check completeness of organizational maintenance allowances and procedures for obtaining replacements.

6 Inspect lettering on name plates and direction plates for legibility.

7 Inspect materiel for paint which has deteriorated or chipped off, exposing bare metal.

GENERAL CAB MAINTENANCE – Section II. Inspection Procedures–Continued

2-10. INSPECTION OF MATERIEL IN THE HANDS OF TROOPS – Continued

8 Determine when materiel was last exercised if not fired recently. Refer to TB-1000-234-30 for exercising.

9 Note general appearance. Check exterior for missing or broken parts.

10 Check storage conditions of general supplies and ammunition.

11 Initiate a thorough report on materiel on "deadline," with reasons for further appropriate action.

12 Report to responsible officer any carelessness, negligence, unauthorized modifications, or tampering. This report should be accompanied by recommendations for correcting unsatisfactory conditions.

13 Inspection will be inclusive of all assemblies and parts described herein. All bolts, screws, nuts, and mounting and locking devices will be securely installed.

14 See that Weapon Record Data entries (DA Form 2408-4) (which provide a continuous record of firings and other related service life data pertaining to weapon tubes) are complete and up-to-date as required by the provisions of DA PAM 738-750.

15 All components and assemblies of the mount will operate smoothly and perform satisfactorily.

16 Painting procedures will conform to those outlined in TM 9-213 and changes.

17 Lubrication must be complete and in accordance with lubrication charts in LO 9-2350-311-12.

18 Cleaning will be performed in accordance with TM 9-2350-311-10 and TM 9-2350-311-20-2.

19 On completion of inspection, all unpainted surfaces will be coated lightly with a film of preservative lubrication oil (PL-medium or CLP per LO 9-2350-311-12).

20 All accessories and spare parts will be inspected for serviceability and completeness.

21 Minor indentations, scratches, or rust pits will not be cause for rejection or replacement of parts unless the damage is of sufficient magnitude to cause unsatisfactory functioning of component or assembly.

2-11. DISASSEMBLY AND ASSEMBLY PROCEDURES

Guidelines

NOTE

Gears, bearings, sleeves and other components mounted on shaft may require use of arbor press for disassembly and assembly.

Complete disassembly of a component is not always necessary to make a required repair or replacement. Good judgment should be used to keep disassembly operations to a minimum.

In disassembling a unit, first follow basic inspection procedures, then remove as many major components and sub-assemblies as possible. These components may then be reduced, as necessary, into individual parts.

During disassembly, tag critical parts such as shims, bearings, and electrical harnesses and leads, to facilitate reassembly. This is especially important for electrical equipment if circuit number tags are illegible or missing.

CAUTION

Never scribe-mark bearing surfaces.

Mark gears on mating teeth by scribe marks, or with dye, indelible ink, or paint, to be certain of correct positioning at assembly. Use of chalk or crayon for marking should be avoided because of lack of permanence.

During assembly, sub-assemblies should be assembled first, combined into major components where possible, and then installed to form a complete component.

Records to provide repair and replacement data and statistics should be carefully prepared and maintained according to DA PAM 738-750.

2-12. REPLACEMENT OF PARTS

a. Unserviceable and unrepairable assemblies will be broken down into Items of Issue, and serviceable parts will be returned to stock. Parts or assemblies which cannot be repaired, selective-fitted, or reclaimed to standards contained in this manual will be salvaged and new parts used to replace them.

b. When assembling components and assemblies, replace damaged keys with new ones, if possible. Tighten all loose screws, bolts, and nuts. Replace all damaged screws, bolts and nuts, if possible.

c. Gaskets, packings, preformed packings, seals, lockwashers, locknuts, cotter pins and spring pins must be replaced. Bushings must be replaced only if removed.

d. Springs must be replaced if broken, kinked, cracked, or do not conform to standards specified in the repair data.

e. If a required part is not available, reconditioning of old part should be considered. Such parts should be inspected carefully after reconditioning to determine their suitability and probable service life. Replacement parts should be requisitioned immediately.

f. Use tools that are suitable for the work to be performed to avoid damage to tools and equipment or injury to personnel.

g. Special tools are listed in Appendix B. Fabricated tools are listed and illustrated in Appendix E. These tools should only be used for maintenance operations for which they were designed, and personnel should be carefully instructed in their specialized operation.

2-13. BALL AND ROLLER BEARINGS

Ref. page 2-7 for general guidelines for inspecting ball bearings. Refer to TM 9-214, "Inspection and Care of Bearings," for cleaning, inspection, and lubrication of bearings, and instructions for evaluation of bearing life.

2-14. REMOVING BURRS, SCRATCHES AND RAISED METAL

a. Use fine mill file, soft stone, or crocus cloth dipped in light oil (Item 11, App. C) to remove burrs, scratches or raised metal.

b. When filing aluminum, clean file often with steel file brush to avoid lodging file with aluminum particles which will gouge work surface.

2-15. REPAIRING DAMAGED THREADS

a. When determined feasible by inspection, damaged threads should be repaired by retapping, use of thread die or by chasing on lathe.

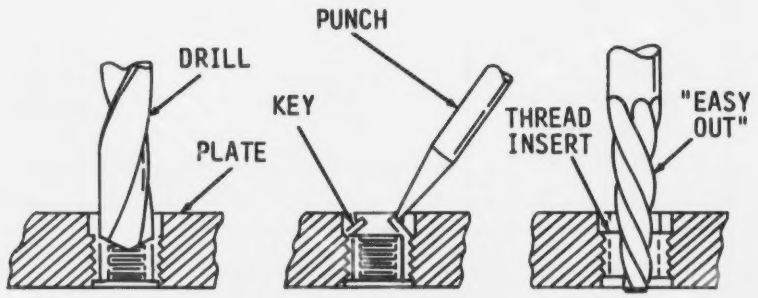
b. Tapped holes for screw thread inserts that have mutilated threads may be repaired by:

1 Drilling and tapping hole oversize and installing larger inserts.

2 Filling tapped hole by welding, redrilling and tapping hole to original size.

2-16. REMOVAL AND INSTALLATION OF SCREW THREAD INSERTS (ONE-PIECE TYPE)

a. Removal



1 Drill thread insert. Refer to table on following page for drill size and depth.

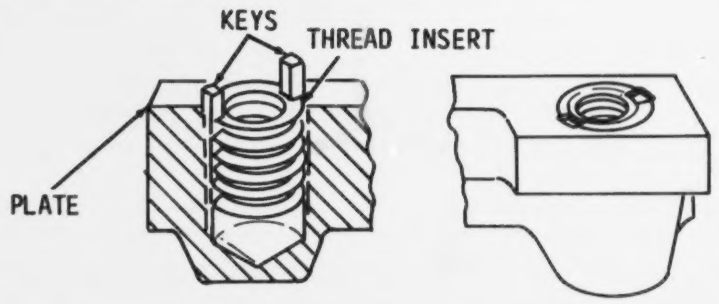
2 Deflect keys inwardly and break off.

3 Remove remainder of thread insert with "Easy Out."

2-16. REMOVAL AND INSTALLATION OF SCREW THREAD INSERTS (ONE PIECE TYPE) – Continued

THREAD INSERT		TAP DRILL Diameter	COUNTERSINK Diameter	REMOVAL DRILL	
Internal Thread	External Thread			Diameter	Drilling Depth
10-24 10-32	3/8-16	Q (.332)	25-64	9/32	1/4
1/4-20 1/4-28	7/16-14	X (.397)	29/64	11/32	1/4
5/16-18 5/16-24	1/2-13	29/64	33/64	13/32	1/4
3/8-16 3/8-24	9/16-12	33-64	37/64	15/32	1/4
7/16-14 7/16-20	5/8-11	37-64	41/64	17/32	1/4
1/2-13 1/2-20	11/16-11	41/64	45/64	19/32	1/4

b. Installation



1 Screw thread insert in until .010 to .030 inch below surface of plate.

2 Drive keys in flush with plate.

2-17. WELDING

For welding instructions and welding materiels, refer to TM 9-237.

2-18. ELECTRICAL TEST EQUIPMENT AND ELECTRICAL TESTING

To use electrical test equipment refer to TM 9-2350-311-20-2, Chapter 3.

2-19. SHAFTS, GEARS AND BEARINGS

Most gears and bearings are installed on shafts tightly. Use arbor press, gear pullers or other appropriate tools for removal and installation. General inspection guidelines for gears and bearings are outlined on page 2-7.

2-20. SOLDERING

For general soldering instructions, see TM 9-2350-311-20-2. For overall soldering procedures, refer to TB SIG 222.

2-21. APPLICATION OF ADHESIVES

a. Clean surfaces to be bonded with toluol cleaner. Surface must be free of grease, paint, talc, soapstone or any foreign substance.

b. Stir adhesives until fluid. Apply an even coat of adhesive to each mating surface. Let dry until tacky. (Temperature and humidity will be controlling factors in drying time).

c. Apply another even coat of adhesive to both coated surfaces. Let dry until tacky (approximately 20 minutes). Adhesive should not transfer to finger when touched lightly.

CAUTION

Do not attempt to pull or pry on either bonded surface after mating.

d. Press rubber or fabric to metal or other mating surface, applying pressure by using a roller or other suitable tool to insure full contact between surfaces.

GENERAL CAB MAINTENANCE – Section IV. Cleaning, Painting and Lubrication

2-22. CLEANING

a. Refer to TM 9-247 for instructions on cleaning; TM 9-208-2 for equipment used in cleaning and TM 9-247 for necessary cleaning materials. Also refer to LO 9-2350-311-12 for specific areas to be cleaned.

WARNING

Breathing vapor from degreasing solutions can cause headache, dizziness, loss of muscular control, coma, permanent brain damage or death. Make sure area is well ventilated as a preventive measure.

b. Cleaning of Materiel Received from Storage

Materiel received by support maintenance units from storage will be cleaned by dip-tank, vapor-degreaser, or steam method, whichever is applicable or available. Descriptions of these methods follow.

CAUTION

Do not immerse sealed-typed ball bearings in dry cleaning solvent PD 680 (Item 7, App. C) or hot oil.

1 Dip-tank method. Disassemble as required, place parts in a perforated metal basket, submerge and agitate in a tank containing dry cleaning solvent PD 680 (Item 7, App. C). Use rubber gloves.

2 Vapor-degreaser method. Tanks containing a heated solution of trichlorethylene or perchloroethylene (Type II) are used for degreasing items that are very greasy or oily and are not readily cleaned by dip-tank method. Place parts in a perforated metal basket, and submerge just below the vapors in the tank, keeping the basket in this position until all the grease, oil, or dirt melts and runs off the parts. If necessary, materiel may be washed with degreasing spray unit.

3 Steam method. Place parts in a perforated metal basket and steam treat until clean. This method is less efficient than the vapor-degreaser method and may require additional cleaning of parts to remove final traces of grease, oil, or dirt, particularly from recesses.

If some time is to elapse before the start of repair operations, apply a coating of light grade preservative oil (Item 11, App. C) to all finished metal surfaces to prevent rusting.

4 Cleaning after repair. After repair operation and prior to assembly, remove shop dirt and other foreign matter from all metal surfaces. This is accomplished by the dip-tank or vapor-degreaser methods or by cleaning with cloths soaked in dry cleaning solvent PD 680 (Item 7 App. C).

5 Cleaning after shop inspection. After in-process shop inspections, dip parts in a tank containing fingerprint remover oil (Item 6, App. C). Remove parts (with rubber gloves), and dry thoroughly with compressed air (provided with moisture filter traps) or by wiping with clean, lint-free dry cloths. Apply preservatives as soon as possible after cleaning.

2-23. PAINTING

a. Clean and repaint all surfaces on which paint has deteriorated or become damaged.

b. Do not paint electrical harnesses or leads.

c. Prime paint interior surfaces including engine compartment, and hull exterior in accordance with TT-P-666.

d. Apply coat of white semi-gloss enamel No. 17875 to interior of cab in accordance with TT-E-489.

e. Paint walkways on hull exterior in accordance with MIL-E-52798 or MIL-E-52835.

f. Refer to TM 9-2350-311-20-2 and TB 43-0209 for application of stencil.

2-24. LUBRICATION

Refer to LO 9-2350-311-12 which covers lubrication for organizational as well as for support maintenance.

GENERAL CAB MAINTENANCE — Secton V. Troubleshooting

2-25. QUICK GUIDE TO TROUBLESHOOTING

a. Purpose

Information in this section is for use by maintenance personnel in conjunction with and as a supplement to, the troubleshooting sections in TM 9-2350-311-10 and TM 9-2350-311-20-2. This section provides a continuation of troubleshooting instructions where a remedy in TM 9-2350-311-20-2 refers to direct or general support maintenance for corrective actions.

The purpose of troubleshooting is to make a quick and accurate diagnosis of a problem in order to correct it without unnecessary labor and expense, to avoid further damage to a component, and to restore vehicle system to full operational capability.

b. General Principles of Troubleshooting

1 Try to identify cause of problem without removing component from vehicle.

2 Determine if continued operation of system with problem would be dangerous or would result in damage to components.

3 If there is a choice between tests to determine what is wrong with a component, make least time-consuming tests first, progressing toward lengthier tests if necessary.

4 Do not perform any disassembly unless a test has first indicated that it is necessary to correct the problem or to conduct a further test.

5 Aside from authorized, scheduled preventive maintenance, do not disassemble any component that is working satisfactorily.

c. Inspection

Always conduct a detailed and thorough visual inspection before operating or disassembling a component. Look for damaged, distorted or deformed parts; loose electrical connections; hydraulic oil leakage; dirt or foreign matter where they shouldn't be; evidence of overheating, as indicated by burnt paint or blued steel; insufficient or excess lubrication; excessive wear; loose fittings or missing fasteners; rust or corrosion; obstructions and interferences with other parts; or anything else that does not look normal.

d. How to Proceed with Troubleshooting

If there is an electrical failure, go first to TM 9-2350-311-20-2 and troubleshoot electrical system, especially if electrical power is necessary to operate component in question. If no electrical failure is involved, go to page 2-22, the QUICK GUIDE TO TROUBLESHOOTING and find component or system affected listed at the left of the page, just below the paragraph heading. The QUICK GUIDE lists an item being checked, problems with item, and a solution or reference to a page where a corrective action for problem can be found. Follow the step-by-step procedure, which progresses from most simple to most complex remedies until problem is corrected.

Other parts of this manual or other manuals may be referenced from time to time. If so, be sure to have these manuals available before beginning actual work.

ITEM	PROBLEM	SOLUTION OR REFERENCE
CAB TRAVERSING	CAB DOES NOT TRAVERSE FREELY OR BINDS UNDER MANUAL OPERATION.	Ref. page 2-25
	CAB DOES NOT TRAVERSE UNDER POWER.	Ref. page 2-27
	CAB CREEPS (TRAVERSES SLOWLY) WHEN GUNNER'S CONTROL IS IN NEUTRAL.	Ref. page 2-29
	MANUAL TRAVERSE HANDWHEEL SLIPS WHEN OPERATED MANUALLY.	Ref. page 2-30
	TRAVERSING MECHANISM OVERHEATS.	Ref. page 2-31
	NOISY OPERATION WHILE TRAVERSING.	Ref. page 2-32

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-25. QUICK GUIDE TO TROUBLESHOOTING – Continued

ITEM	PROBLEM	SOLUTION OR REFERENCE
CANNON ELEVATION	CANNON DOES NOT ELEVATE OR DEPRESS UNDER POWER FROM EITHER GUNNER'S OR ASSISTANT GUNNER'S CONTROL.	Ref. page 2-33
	CANNON WILL NOT ELEVATE OR DEPRESS USING MANUAL ELEVATION SYSTEM.	Ref. page 2-35
	CANNON DOES NOT ELEVATE OR DEPRESS SMOOTHLY.	Ref. page 2-36
	CANNON CREEPS DOWN OR UP.	Ref. page 2-37
	EFFORT REQUIRED TO ELEVATE CANNON IS GREATER THAN EFFORT REQUIRED TO DEPRESS.	Ref. page 2-39
	EFFORT REQUIRED TO DEPRESS CANNON IS GREATER THAN EFFORT REQUIRED TO ELEVATE.	Ref. page 2-40
	MANUAL ELEVATING HAND PUMP HANDLE SPINS WHEN RELEASED.	Ref. page 2-41
	ASSISTANT GUNNER'S CONTROL DOES NOT FUNCTION WHEN ELEVATION CONTROL SWITCH IS MOVED TO NO. 1 MAN POSITION.	Ref. page 2-42
	CANNON ELEVATES BUT WILL NOT DEPRESS OR DEPRESSES BUT WILL NOT ELEVATE.	Ref. page 2-43
	ELEVATION HAND PUMP INOPERATIVE OR INEFFICIENT.	Ref. page 2-44
	HYDRAULIC FLUID LEAKING FROM FRONT OR REAR OF ELEVATING CYLINDER.	Ref. page 2-45

ITEM	PROBLEM	SOLUTION OR REFERENCE
RAMMER	RAMMER DOES NOT OPERATE.	Ref. page 2-46
POWERPACK AND HYDRAULICS	SYSTEM CANNOT BE ACTIVATED TO BUILD UP PRESSURE.	Ref. page 2-48
	SYSTEM WILL NOT DEVELOP FULL OPERATING PRESSURE AND POWERPACK MOTOR OPERATES CONTINUOUSLY.	Ref. page 2-51
	SYSTEM OVERCHARGES.	Ref. page 2-54
	OVERFLOW OF FLUID THROUGH FILLER CAP.	Ref. page 2-55
	MAIN ACCUMULATOR WILL NOT HOLD DRY NITROGEN CHARGE.	Ref. page 2-56
GUNNER'S CONTROL AND ASSISTANT GUNNER'S CONTROL	HANDLE DOES NOT RETURN TO NEUTRAL POSITION WHEN RELEASED.	Ref. page 2-57
	HANDLE INOPERATIVE AFTER REBUILD.	Ref. page 2-58
	HANDLE BINDS WHEN TRAVERSING.	Ref. page 2-59

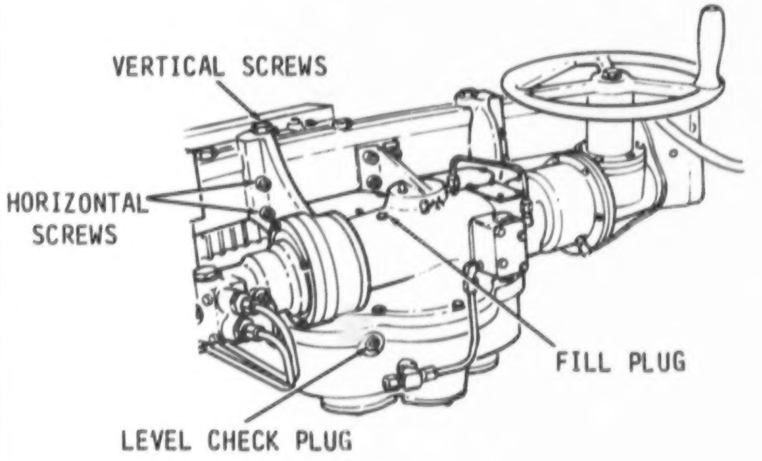
GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

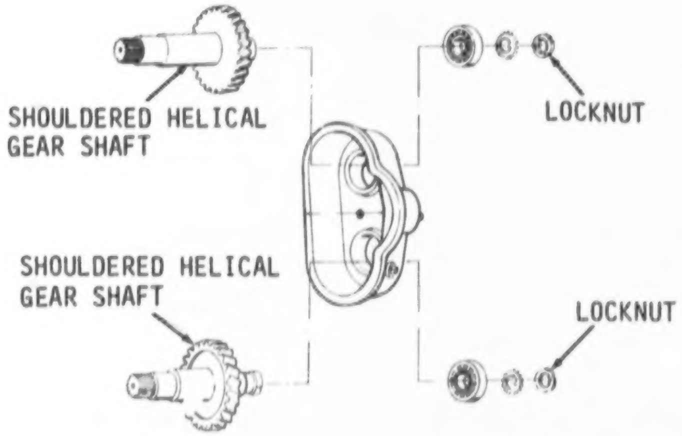
2-25. QUICK GUIDE TO TROUBLESHOOTING – Continued

ITEM	PROBLEM	SOLUTION OR REFERENCE
CANNON M185	BREECH MECHANISM DOES NOT OPERATE FREELY.	Ref. page 2-61
	BREECHBLOCK DOES NOT CLOSE COMPLETELY.	Ref. page 2-63
	BREECH MECHANISM WILL NOT OPEN MANUALLY.	Ref. page 2-65
	BREECH MECHANISM WILL NOT OPEN AUTOMATICALLY AFTER FIRING.	Ref. page 2-67
	OVER ROTATION OR JAMMED BREECHBLOCK.	Ref. page 2-68
	GASES ACCUMULATE IN CAB AFTER FIRING.	Ref. page 2-70
	EXCESSIVE RECOIL FORCE.	Ref. page 2-70
	TUBE LANDS FLATTENED, CHIPPED, ABRADED OR RAISED, OR TUBE COPPERED.	TM 9-1000-202-14
MOUNT 178	EXCESSIVE RECOIL TRAVEL.	Ref. page 2-71
	INSUFFICIENT RECOIL TRAVEL.	Ref. page 2-72
	CANNON DOES NOT RETURN TO BATTERY.	Ref. page 2-73
	CANNON RETURNS TO BATTERY WITH EXCESSIVE FORCE.	Ref. page 2-74
	INSUFFICIENT HYDRAULIC PRESSURE IN VARIABLE RECOIL CYLINDER.	Ref. page 2-74
PANORAMIC TELESCOPE BALLISTIC COVER	EXTREME EFFORT REQUIRED TO TRAVERSE COVER.	Ref. page 2-75

2-26. CAB TRAVERSING

CAB DOES NOT TRAVERSE FREELY OR BINDS UNDER MANUAL OPERATION.


VERTICAL SCREWS
HORIZONTAL SCREWS
FILL PLUG
LEVEL CHECK PLUG


SHOULDERED HELICAL GEAR SHAFT
LOCKNUT
SHOULDERED HELICAL GEAR SHAFT
LOCKNUT

1 Check lubricating oil level in traversing mechanism.

Refill to proper level if low (ref. LO 9-2350-311-12).

2 Check for loose screws or improper installation.

Torque two vertical screws to 320 lb-ft (433 N·m) and eight horizontal screws to 80-100 lb-ft (108-136 N·m). If traversing mechanism is not installed properly, install properly (ref. page 9-66).

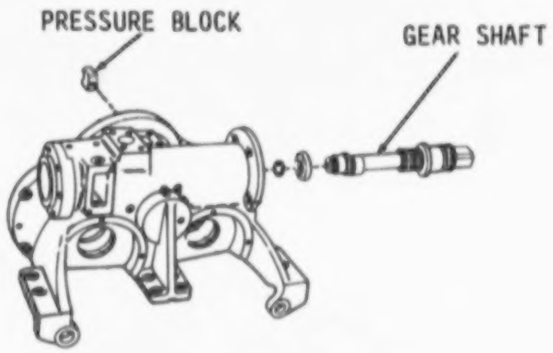
3 Check for loose locknuts or shouldered helical gear shafts.

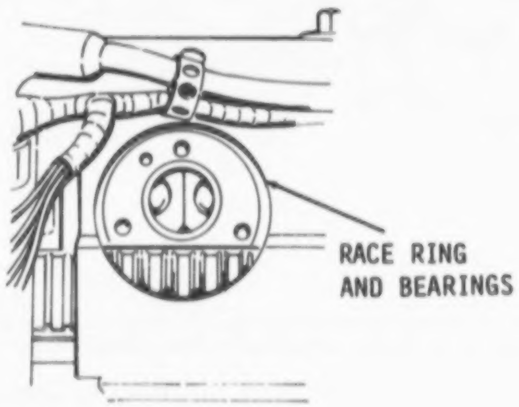
Tighten locknuts if loose (ref. page 9-60).

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-26. CAB TRAVERSING – Continued

CAB DOES NOT TRAVERSE FREELY OR BINDS UNDER MANUAL OPERATION.





4 Check for pressure block binding on gear shaft.

Adjust pressure block properly (ref. page 9-63).

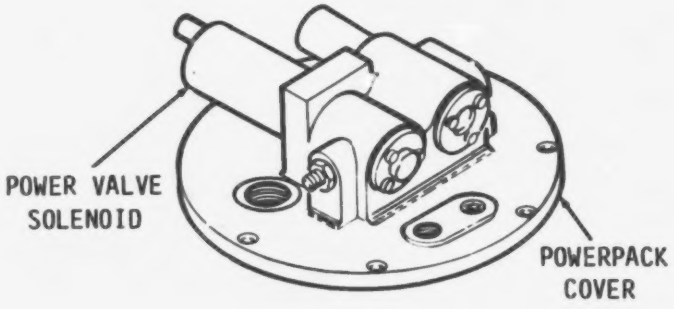
5 Inspect traversing mechanism for other damage.

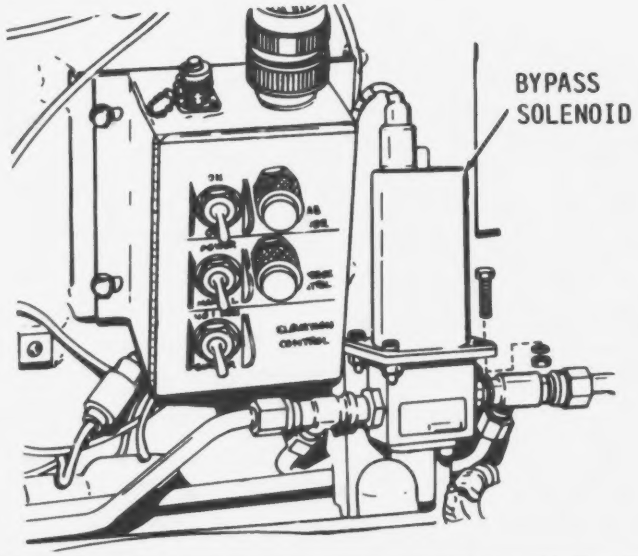
Repair any damage (ref. page 9-58).

6 Inspect cab race ring for damage.

Remove cab and race ring. Inspect and repair race ring and bearings (ref. page 3-19).

CAB DOES NOT TRAVERSE UNDER POWER.





1 Check for faulty power solenoid or bypass solenoid.

Move CAB POWER switch to ON and OFF positions. If power solenoid cannot be heard to operate, solenoid is defective or lead-in (power) circuit is open.

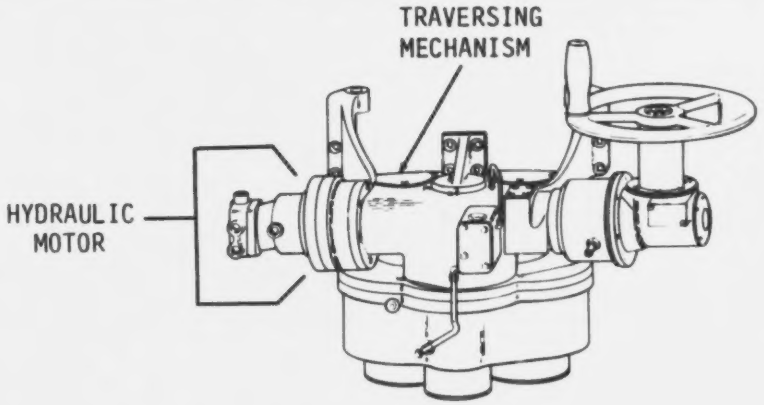
Exercise TRAVERSE CONTROL switch and listen for operation of bypass solenoid. If either is inoperative, ref. TM 9-2350-311-20-2, and troubleshoot cab traversing circuit.

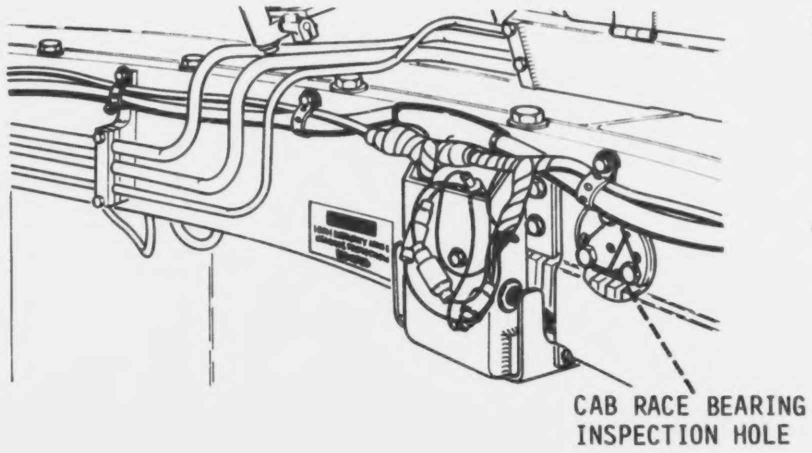
2 Check operating pressure in main accumulator.

If system cannot develop full hydraulic pressure, troubleshoot powerpack (ref. page 2-51).

2-26. CAB TRAVERSING – Continued

CAB DOES NOT TRAVERSE UNDER POWER.


TRAVERSING
MECHANISM
HYDRAULIC
MOTOR


CAB RACE BEARING
INSPECTION HOLE

3 Check for faulty gunner's control.

Repair or replace gunner's control (ref. page 5-160).

4 Check for damaged or improperly installed traversing mechanism.

Repair damage or install properly (ref. page 9-58).

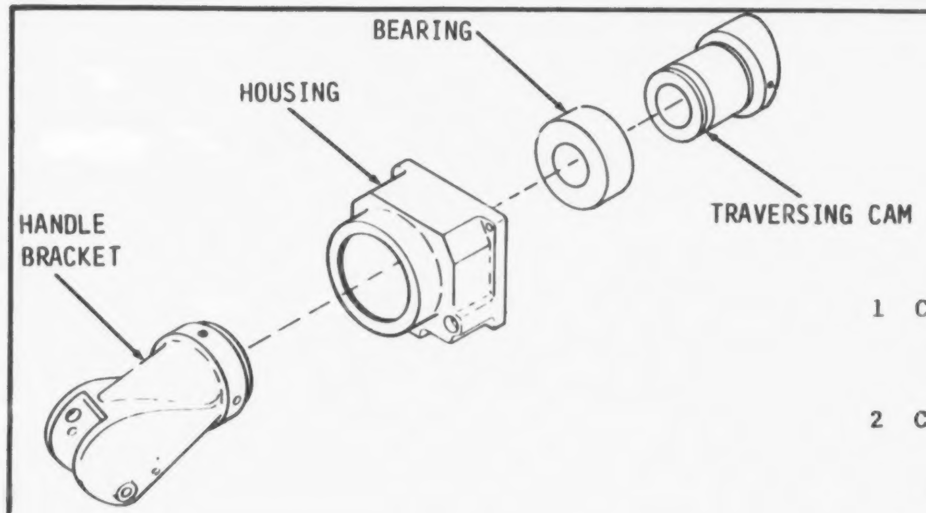
5 Check for damaged ring gear or cab race bearings.

Remove cab and race ring and repair or replace race ring or bearings (ref. page 3-19).

6 Check traversing mechanism hydraulic motor.

Repair or replace motor (ref. page 9-33).

CAB CREEPS (TRAVERSES SLOWLY) WHEN GUNNER'S CONTROL IS IN NEUTRAL.


BEARING
HOUSING
HANDLE BRACKET
TRAVERSING CAM

1 Check position of gunner's control handle.

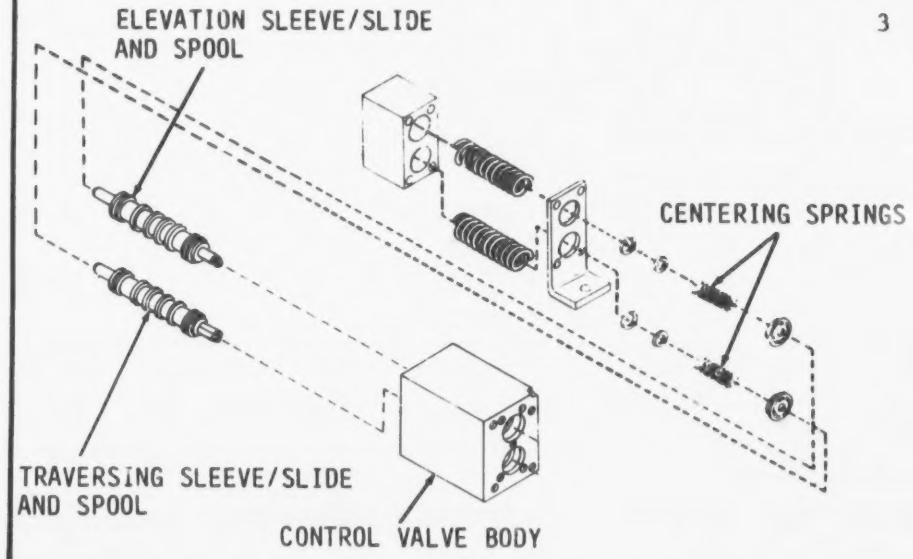
Handle must be in neutral position.

2 Check for traversing cam bearing in housing.

Repair traversing cam and housing (ref. page 5-188).

3 Check internal parts of gunner's control assembly.

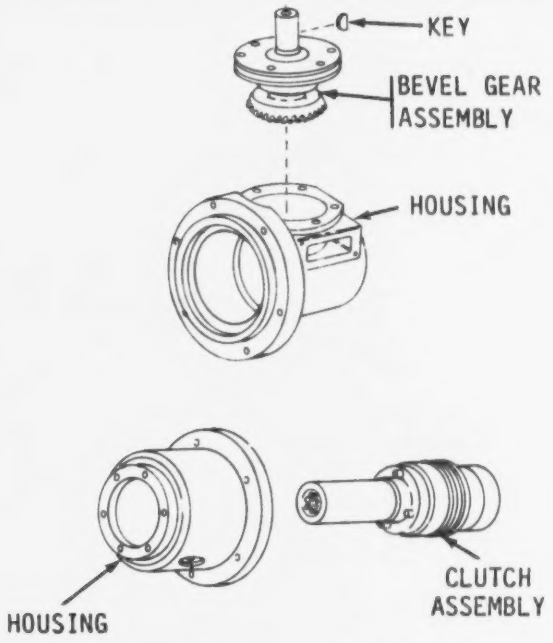
Repair or replace traversing sleeves and slides or centering springs, if faulty (ref. page 5-196).


ELEVATION SLEEVE/SLIDE AND SPOOL
CENTERING SPRINGS
TRAVERSING SLEEVE/SLIDE AND SPOOL
CONTROL VALVE BODY

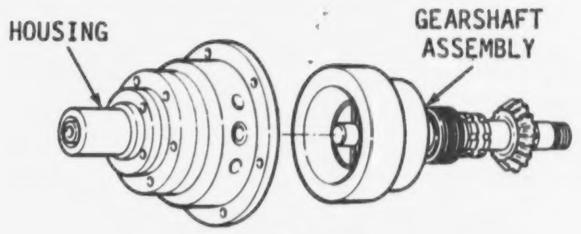
GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-26. CAB TRAVERSING – Continued

MANUAL TRAVERSE HANDWHEEL SLIPS WHEN OPERATED MANUALLY.


KEY
BEVEL GEAR ASSEMBLY
HOUSING
HOUSING
CLUTCH ASSEMBLY

M109A2/M109A3 HOWITZERS


HOUSING
GEARSHAFT ASSEMBLY

M109A4 HOWITZERS

1 Check for sheared or missing key in bevel gear shaft.

Replace key (ref. page 9-45).

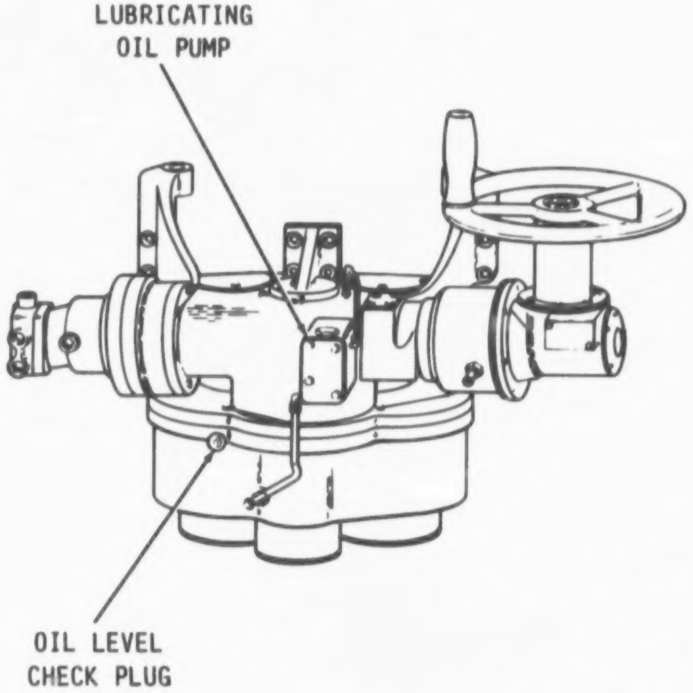
2 Check clutch assembly or gearshaft assembly.

Replace clutch assembly or repair gearshaft assembly if faulty (ref. page 9-46 or page 9-48.2).

3 Check for broken gear teeth in traversing mechanism.

Replace bevel gears as required (ref. page 9-49).

TRAVERSING MECHANISM OVERHEATS.


LUBRICATING OIL PUMP
OIL LEVEL CHECK PLUG

1 Check for low oil level.

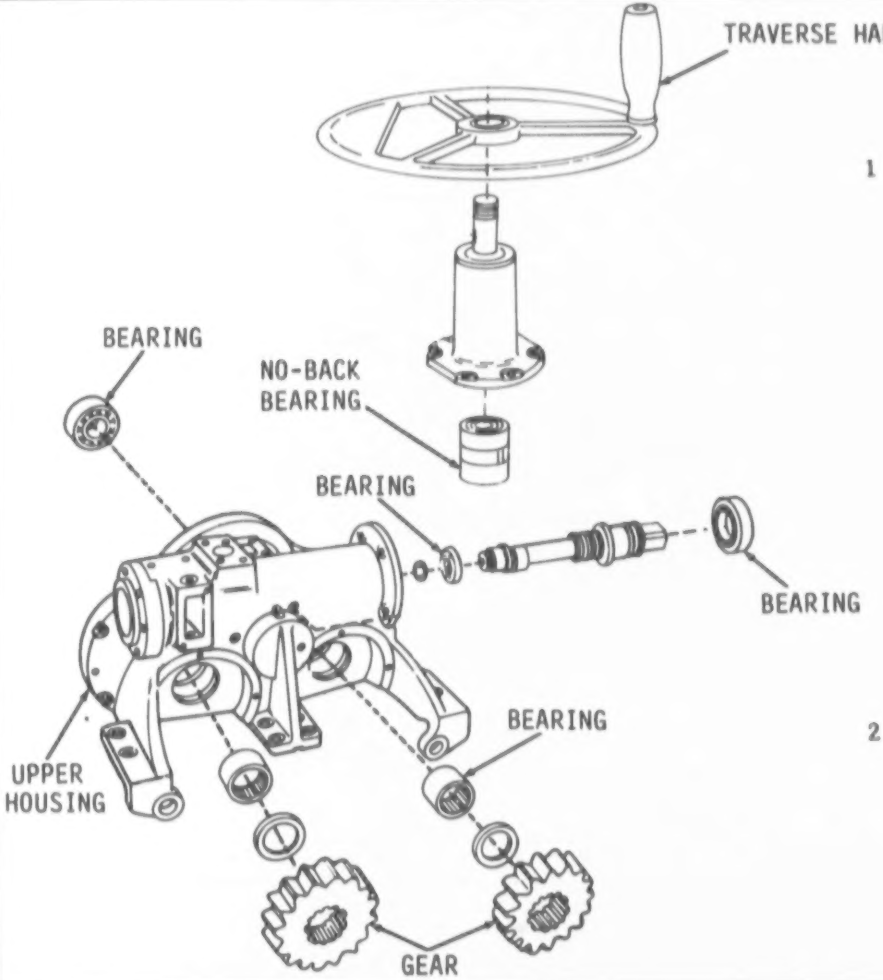
Refill as required in accordance with LO 9-2350-311-12.

2 Check for faulty lubricating pump.

Repair or replace pump as required (ref. page 9-10).

2-26. CAB TRAVERSING – Continued

NOISY OPERATION WHILE TRAVERSING.


TRAVERSE HANDWHEEL
BEARING
NO-BACK BEARING
BEARING
BEARING
BEARING
UPPER HOUSING
GEAR

1 Check for faulty no-back bearing.

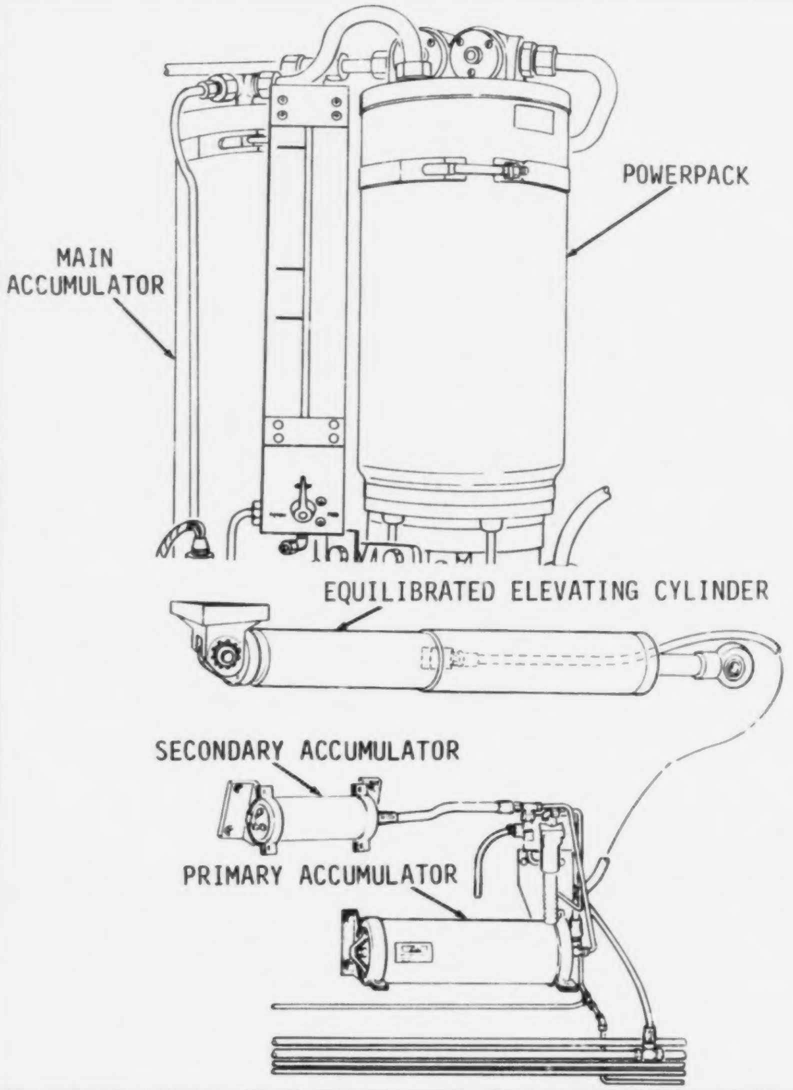
Remove manual traverse handwheel and replace no-back bearing (ref. page 9-41).

2 Check for damaged gears and/or bearings.

Repair or replace traversing mechanism (ref. page 9-50).

2-27. CANNON ELEVATION

CANNON DOES NOT ELEVATE OR DEPRESS UNDER POWER FROM EITHER GUNNER'S OR ASSISTANT GUNNER'S CONTROL.



1 Check operational condition of vehicle hydraulic system.

Traverse under hydraulic power. If power traverse is available, the problem is not with the powerpack or the hydraulic system. If hydraulic power is not available for traverse, troubleshoot the powerpack (ref. page 2-48).

2 Check operation of equilibrated elevating cylinder assembly.

Elevate and depress the cannon using manual elevation system only. If it operates, the problem is not with the equilibrated elevating cylinder or the equilibrated elevating system. If cannon cannot be elevated or depressed manually, check pressure of the nitrogen charge in both the primary and the secondary accumulators and recharge as necessary (ref. page 5-75 and 5-95). Adjust equilibrated elevating system after charging accumulators (ref. TM 9-2350-311-10).

NOTE

If cannon does not elevate or depress from only one of the gunner's controls, troubleshoot gunner's unit (ref. page 2-57).

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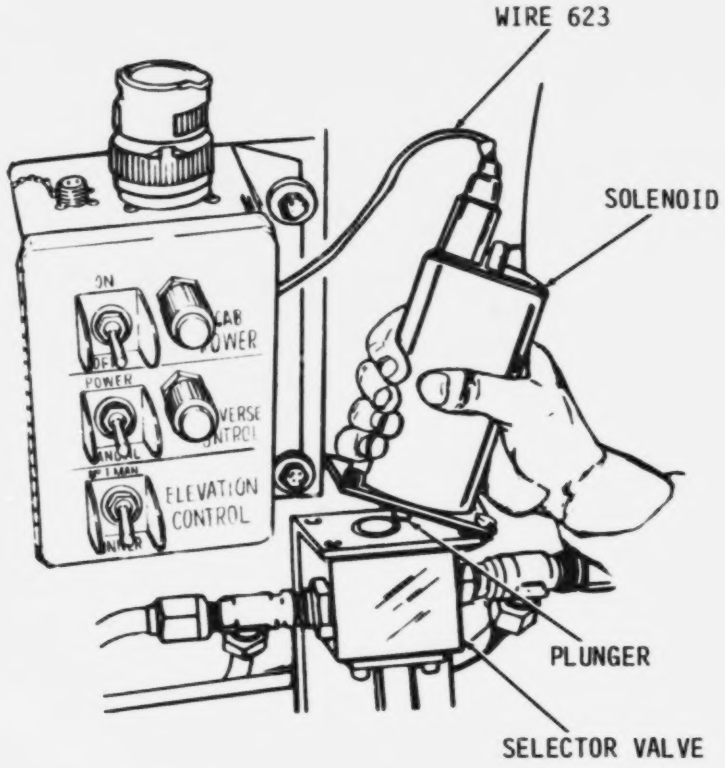
2-27. CANNON ELEVATION – Continued

CANNON DOES NOT ELEVATE OR DEPRESS UNDER POWER FROM EITHER GUNNER'S OR ASSISTANT GUNNER'S CONTROL.


WIRE 623
SOLENOID
ON
CAB POWER
POWER
TRAVERSE CONTROL
ELEVATION CONTROL
PLUNGER
SELECTOR VALVE

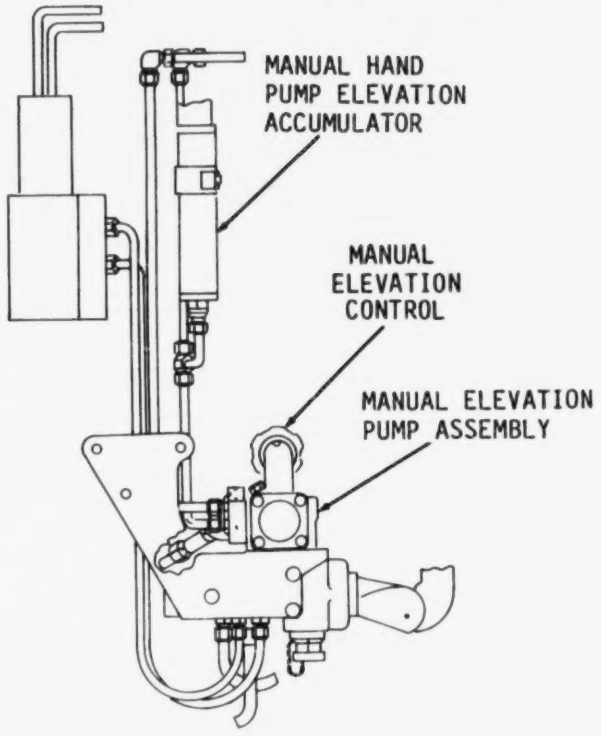
3 Check operation of elevation selector valve solenoid.

Repair or replace solenoid (ref. TM 9-2350-311-20-2).

4 Check operation of elevation selector valve assembly.

Repair or replace elevation selector valve assembly (ref. page 5-156).

CANNON WILL NOT ELEVATE OR DEPRESS USING MANUAL ELEVATION SYSTEM.


MANUAL HAND PUMP ELEVATION ACCUMULATOR
MANUAL ELEVATION CONTROL
MANUAL ELEVATION PUMP ASSEMBLY

SIDE VIEW

1 Check operation of equilibrated elevating cylinder and mechanism.

Elevate and depress cannon under power. If system malfunctions, go to Step 2. If system works correctly, go to Step 3.

2 Check for air in hydraulic system.

Bleed hydraulic system of air (ref. TM 9-2350-311-20-2).

3 Check pressure of nitrogen charge in manual hand pump elevation accumulator.

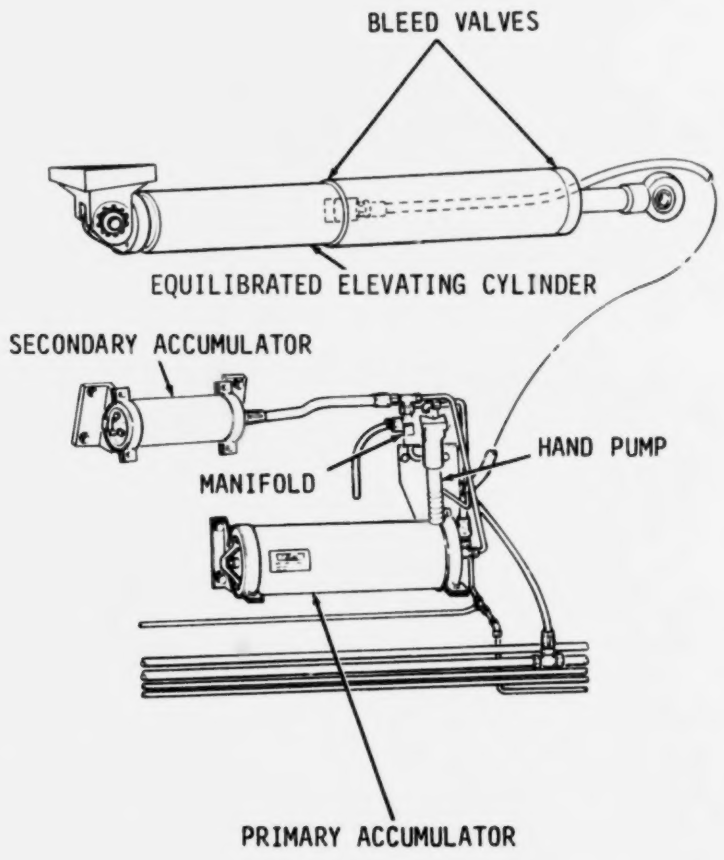
Nitrogen pressure should be 75-90 psi (517-620 kPa). Recharge as necessary (ref. page 5-42). Check to see that accumulator holds nitrogen after recharging and has no leaks. If accumulator fails to hold charge, remove, repair, (ref. page 5-37), and replace.

4 Check manual elevation pump assembly.

If cannon will not elevate or depress by use of manual elevation pump, repair or replace pump (ref. pages 5-169 and 5-182).

2-27. CANNON ELEVATION – Continued

CANNON DOES NOT ELEVATE OR DEPRESS SMOOTHLY.


BLEED VALVES
EQUILIBRATED ELEVATING CYLINDER
SECONDARY ACCUMULATOR
MANIFOLD
HAND PUMP
PRIMARY ACCUMULATOR

1 Check for air entrapped in equilibrated elevation hydraulic system.

Bleed air from equilibrated elevation hydraulic system (ref. TM 9-2350-311-20-2).

2 Check for internal leak in primary accumulator.

Nitrogen will be leaking past the floating piston, entering the "wet" side of the accumulator, causing erratic or rough operation of the equilibrated elevating system. Remove and repair primary accumulator assembly (ref. page 5-71).

3 Check for internal nitrogen leak in secondary accumulator.

Nitrogen will be leaking past the floating piston, entering the "wet" side of the accumulator, causing erratic or rough operation of the equilibrated elevating system. Remove and repair secondary accumulator assembly (ref. page 5-95).

CANNON CREEPS DOWN OR UP.

1 **Check for air in equilibrated elevating cylinder.**

Bleed hydraulic system and fill to proper level (ref. TM 9-2350-311-20-2). Elevate and depress cannon to see if creeping has stopped. Observe equilibrated elevating cylinder for leaks and excessive nitrogen pressure TM 9-2350-303-34-2 (ref. page 2-17).

2 **Check for defective locking valve.**

Replace if necessary (ref. page 5-146).

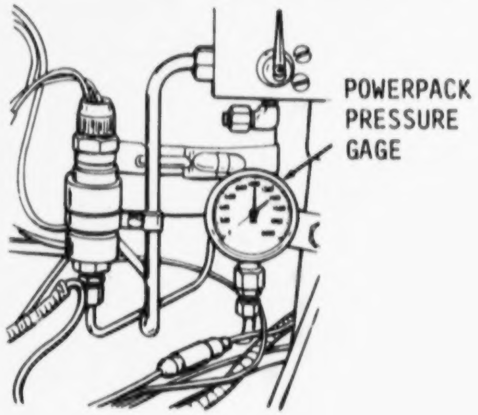
3 **Check for hydraulic leaks in equilibrated elevation system.**

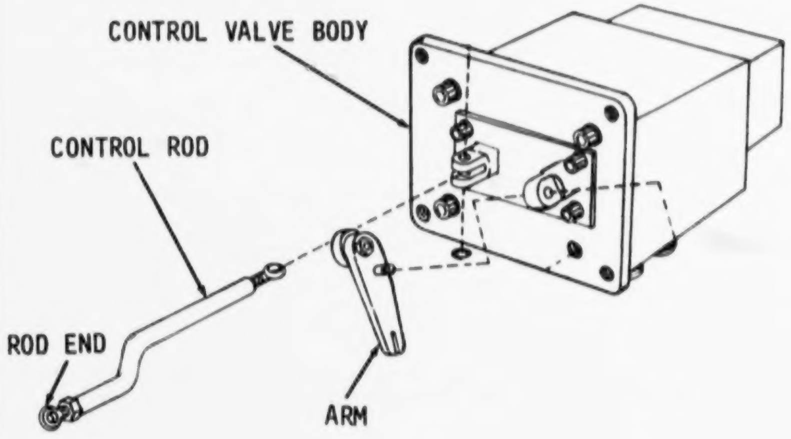
Look at equilibrated elevating cylinder, connections, locking valve and lines. Tighten loose connections. Replace leaking or damaged lines (ref. TM 9-2350-311-20-2).

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-27. CANNON ELEVATION – Continued

CANNON CREEPS DOWN AND UP.





4 Check hydraulic pressure in powerpack during operation.

Elevate and depress cannon. Observe cylinder and locking valve for leakage during actuation. Observe hydraulic pressure of powerpack. If powerpack pressure is too high or too low, troubleshoot powerpack (ref. page 2-54). If locking valve leaks or is open, replace or repair (ref. page 5-146).

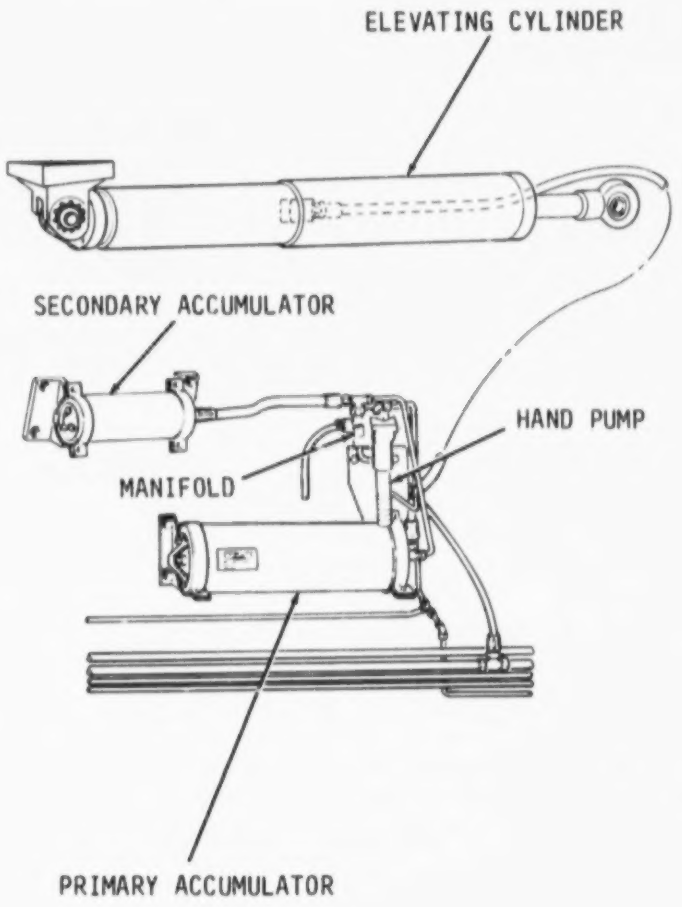
5 Check gunner's and assistant gunner's controls for improperly adjusted or disconnected elevation control rods.

Disconnect handle from bracket and rod from handle. Turn rod end to lengthen or shorten handle control rod. Staighten rod if bent. Repair and assemble (ref. page 5-192).

6 Check for nitrogen charge leaking past floating piston in primary accumulator.

Repair primary accumulator (ref. page 5-75).

EFFORT REQUIRED TO ELEVATE CANNON IS GREATER THAN EFFORT REQUIRED TO DEPRESS.


ELEVATING CYLINDER
SECONDARY ACCUMULATOR
HAND PUMP
MANIFOLD
PRIMARY ACCUMULATOR

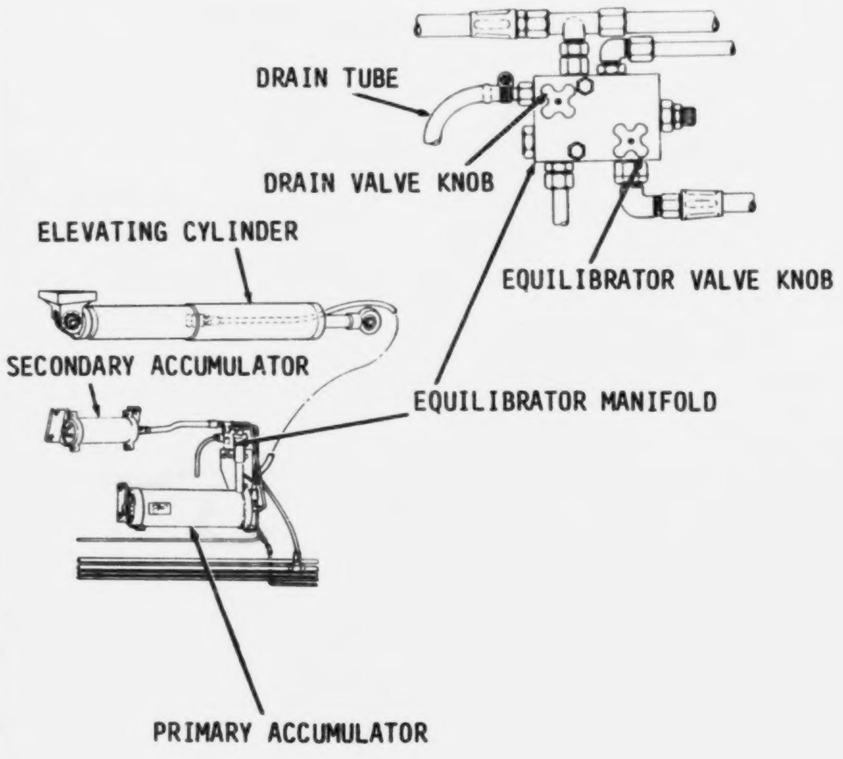
Check for improperly adjusted elevating system.

Adjust elevating cylinder. Use equilibrator hand pump to increase pressure in system (ref. TM 9-2350-311-20-2).

GENERAL CAB MAINTENANCE — Section V. Troubleshooting—Continued

2-27. CANNON ELEVATION — Continued

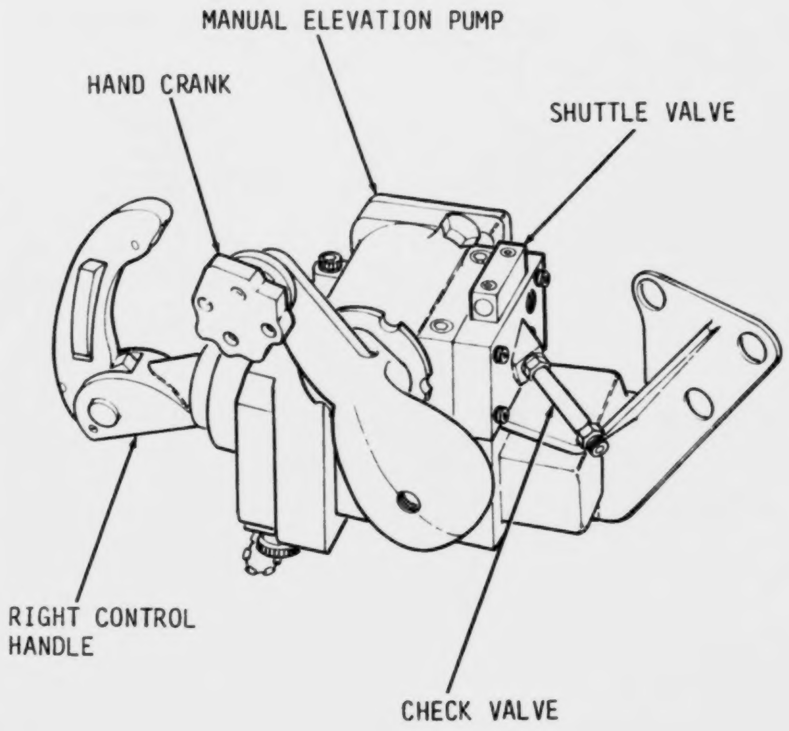
EFFORT REQUIRED TO DEPRESS CANNON IS GREATER THAN EFFORT REQUIRED TO ELEVATE.


DRAIN TUBE
DRAIN VALVE KNOB
ELEVATING CYLINDER
EQUILIBRATOR VALVE KNOB
SECONDARY ACCUMULATOR
EQUILIBRATOR MANIFOLD
PRIMARY ACCUMULATOR

Check for improperly adjusted elevation system.

Adjust elevating cylinder. Reduce pressure by slowly opening system drain valve on equilibrator manifold (ref. TM 9-2350-311-20-2).

MANUAL ELEVATING HAND PUMP HANDLE SPINS WHEN RELEASED.


MANUAL ELEVATION PUMP
HAND CRANK
SHUTTLE VALVE
RIGHT CONTROL HANDLE
CHECK VALVE

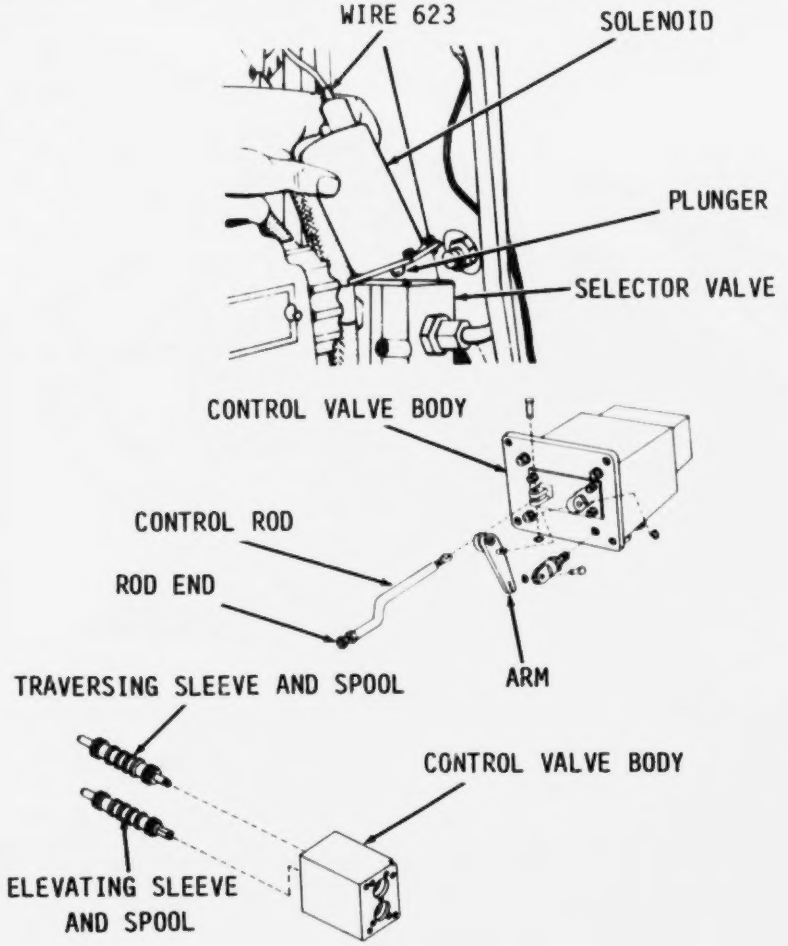
Check for improper sealing of check valve.

Repair or replace check valve (ref. page 5-165).

GENERAL CAB MAINTENANCE — Section V. Troubleshooting—Continued

2-27. CANNON ELEVATION — Continued

ASSISTANT GUNNER'S CONTROL DOES NOT FUNCTION WHEN ELEVATION CONTROL SWITCH IS MOVED TO NO. 1 MAN POSITION.


WIRE 623
SOLENOID
PLUNGER
SELECTOR VALVE
CONTROL VALVE BODY
CONTROL ROD
ROD END
ARM
TRAVERSING SLEEVE AND SPOOL
CONTROL VALVE BODY
ELEVATING SLEEVE AND SPOOL

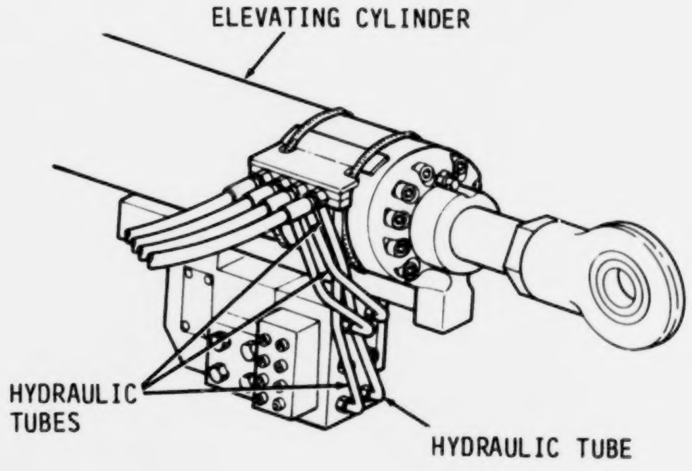
1 Check operation of elevation selector switch, solenoid and valve.

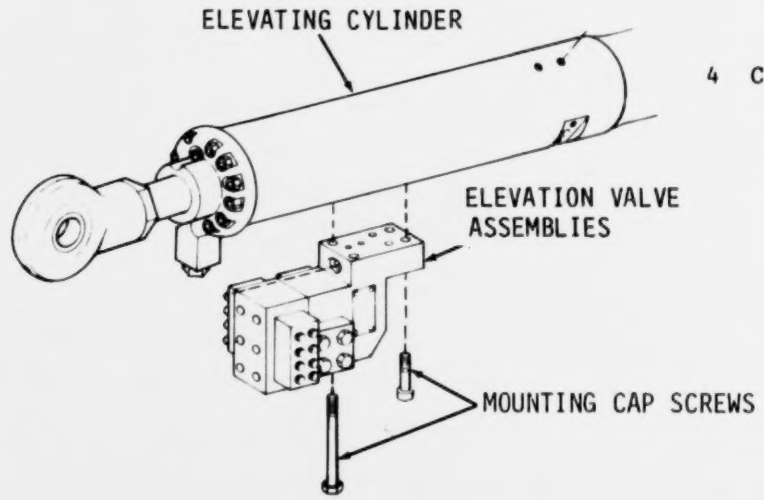
Ref. TM 9-2350-311-20-2.

2 Check operation of gunner's control.

Look for disconnected elevation control rod, or faulty or improperly assembled elevation spool. Repair or replace gunner's control (ref. pages 5-158 and 5-192).

CANNON ELEVATES BUT WILL NOT DEPRESS OR DEPRESSES BUT WILL NOT ELEVATE.


ELEVATING CYLINDER
HYDRAULIC TUBES
HYDRAULIC TUBE


ELEVATING CYLINDER
ELEVATION VALVE ASSEMBLIES
MOUNTING CAP SCREWS

1 Inspect elevating cylinder, linkage and hydraulic lines for damage and leaks.

Repair as necessary.

2 Check for overtightened relief and locking valve group mounting cap screws, (ref. page 5-111).

3 Check for faulty elevating cylinder locking valve.

Repair or replace locking valve (ref. page 5-111).

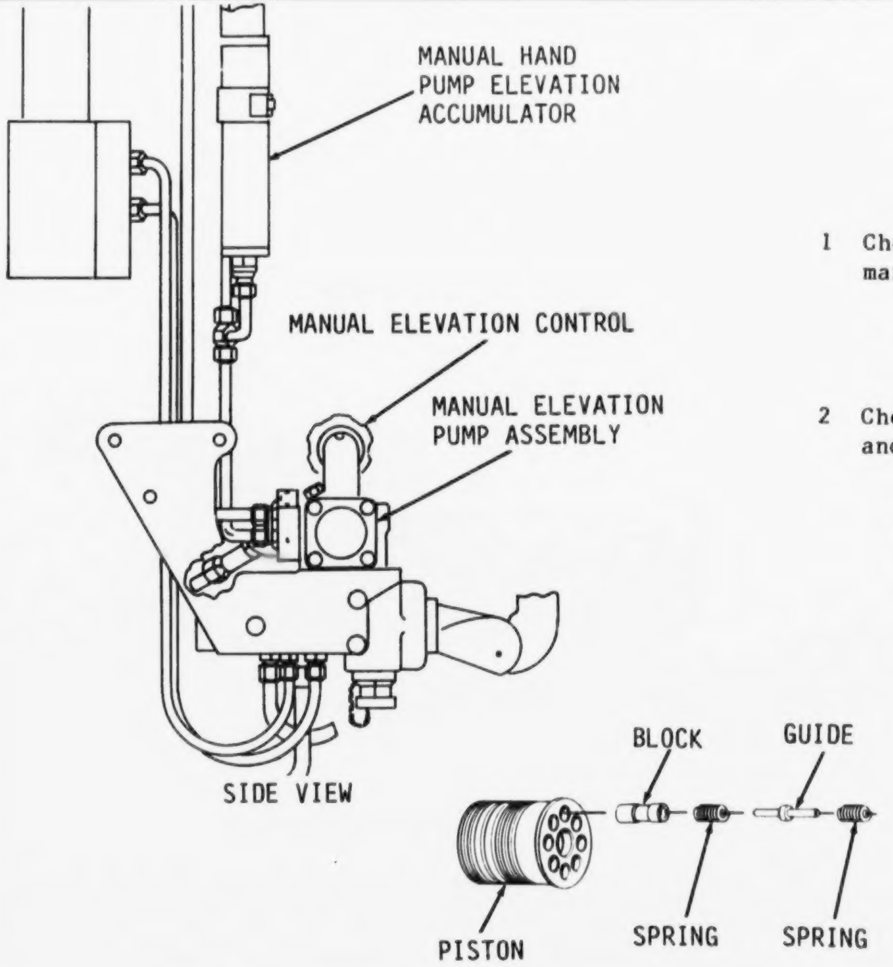
4 Check for faulty elevating cylinder.

Repair or replace elevating cylinder as required (ref. page 5-111).

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-27. CANNON ELEVATION – Continued

ELEVATION HAND PUMP INOPERATIVE OR INEFFICIENT.


MANUAL HAND PUMP ELEVATION ACCUMULATOR
MANUAL ELEVATION CONTROL
MANUAL ELEVATION PUMP ASSEMBLY
SIDE VIEW
BLOCK
GUIDE
PISTON
SPRING
SPRING

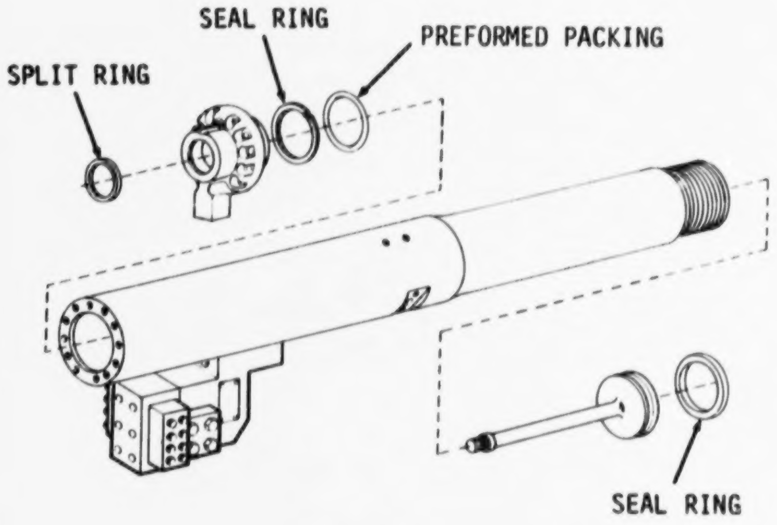
1 Check for correct nitrogen charge pressure in manual hand pump elevation accumulator.

Charge manual hand pump elevation accumulator (ref. page 5-42)

2 Check for excessive clearance between pistons and block or for faulty piston springs.

Remove, disassemble, inspect, and repair manual elevation pump assembly (ref. page 5-40).

HYDRAULIC FLUID LEAKING FROM FRONT OR REAR OF ELEVATING CYLINDER.


SEAL RING
PREFORMED PACKING
SPLIT RING
SEAL RING

Check for leaking elevating cylinder seals.

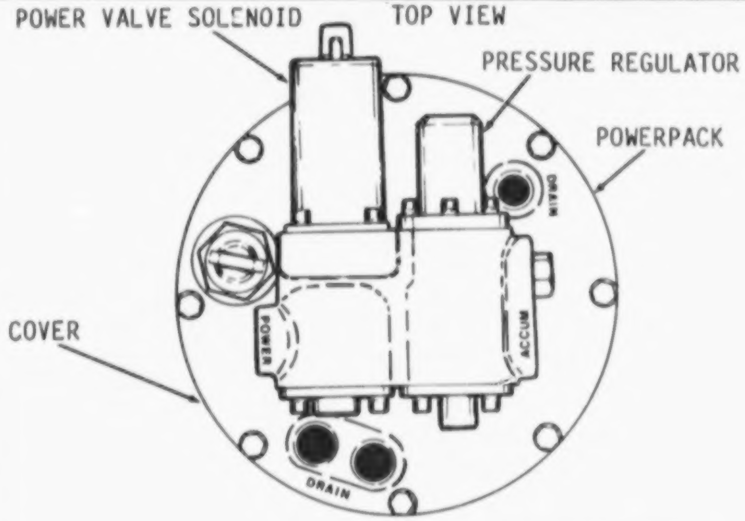
1 Depress and elevate cannon to exercise elevating cyclinder. If leaks persist, replace elevating cyclinder seal rings, split ring and perform packing.

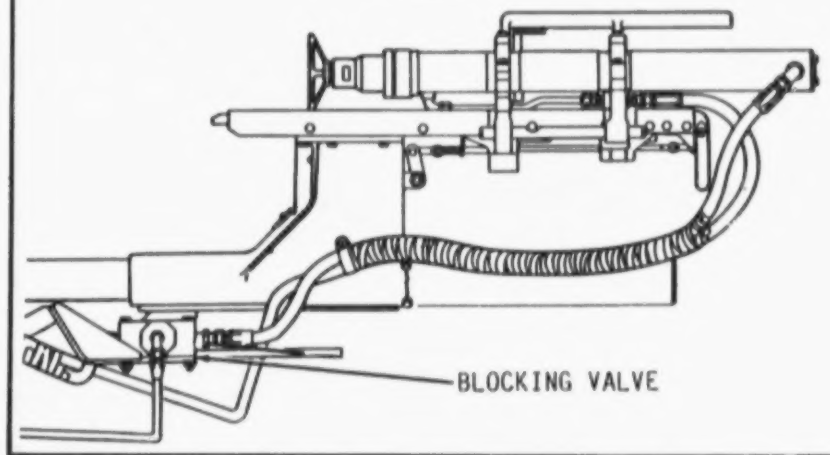
2 Check for excessive nitrogen pressure in primary and secondary accumulators.

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-28. RAMMER

RAMMER DOES NOT OPERATE.


POWER VALVE SOLENOID
TOP VIEW
PRESSURE REGULATOR
POWERPACK
DRAIN
COVER
POWER
ACCUM
DRAIN

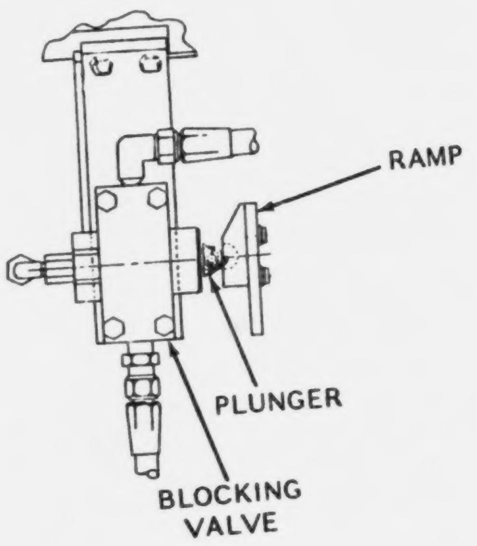

BLOCKING VALVE

1 Check for hydraulic power.

Turn CAB POWER switch to ON and listen for power valve solenoid operation. Allow hydraulic system to charge. If hydraulic system will not charge, troubleshoot system (ref. page 2-48).

2 Check adjustment.

If rammer cyclinder fails to extend, examine blocking valve to be sure that the plunger on the blocking valve is being actuated by the ramp on the rammer. If the ramp is not engaging the plunger, loosen the mounting bolts of the support bracket (ref. page 6-4), and adjust.


RAMP
PLUNGER
BLOCKING VALVE

3 Check for defective blocking valve.

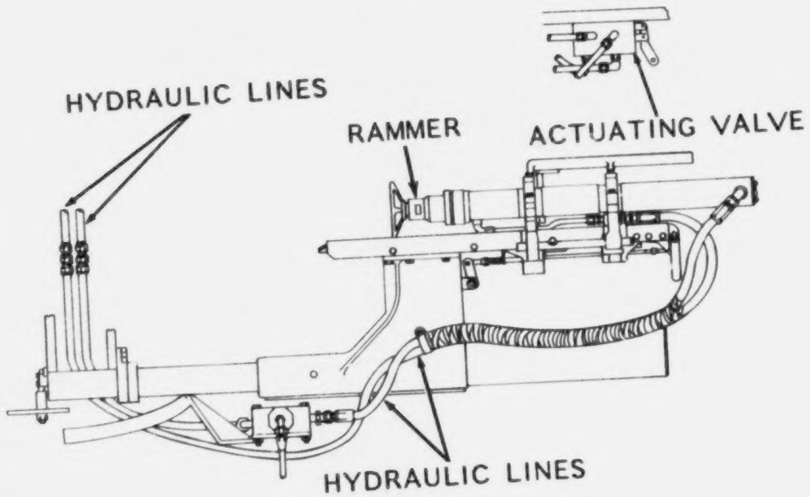
Push in plunger by hand. Note if it extends when released. If plunger does not extend, replace blocking valve (ref. page 6-2).

4 Check for defective rammer actuating valve.

Replace rammer actuating valve (ref. page 6-36).

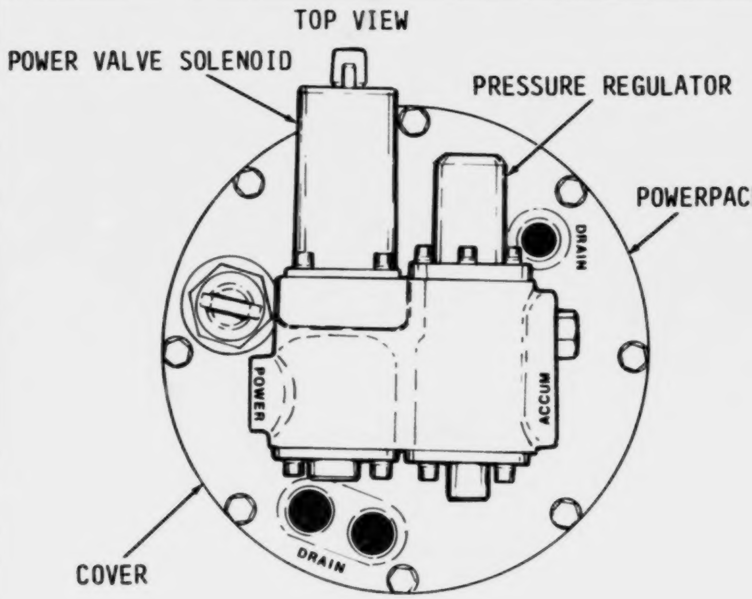
5 Check for leaks and obstructions.

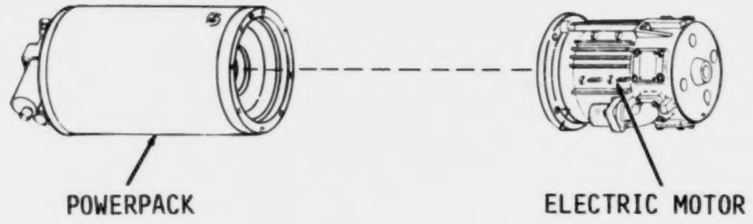
Repair all leaks. Tighten loose connections or replace defective tube fittings. Replace leaking hoses. Check rammer to be sure no parts are distorted or damaged, obstructing its operation. Repair rammer mechanical parts as necessary (ref. page 6-13).


HYDRAULIC LINES
RAMMER
ACTUATING VALVE
HYDRAULIC LINES

2-29. POWERPACK AND HYDRAULICS

SYSTEM CANNOT BE ACTIVATED TO BUILD UP PRESSURE.


TOP VIEW
POWER VALVE SOLENOID
PRESSURE REGULATOR
POWERPACK
DRAIN
POWER
ACCUM
DRAIN
COVER


POWERPACK
ELECTRIC MOTOR

1 Check to see if CAB POWER switch is in OFF position.

Turn CAB POWER switch to ON position. If there is no power, go to Step 2. If there is power and if the power valve solenoid is heard to operate, go to Step 3.

2 Check for electrical system failure.

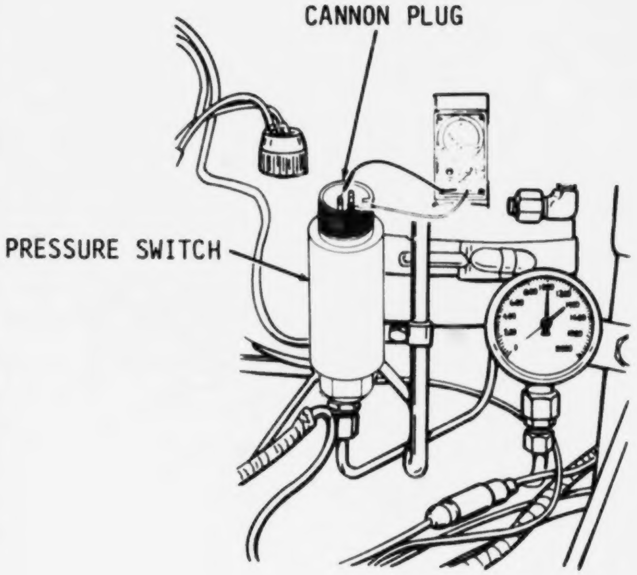
Troubleshoot electrical system (ref. TM 9-2350-311-20-2), then perform Steps 3 thru 5.

3 Check for defective electric drive motor.

If motor has power and does not operate, replace motor (continue with Step 4 below).

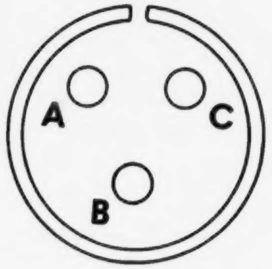
If motor runs continuously but does not build up pressure within 4 minutes, check for a faulty safety relief valve (ref. page 2-52) or for low nitrogen pressure in main accumulator (ref. page 2-56).

Remove motor from powerpack (ref. page 5-3). Check for damaged electric drive motor coupling, loose mounting setscrews, and disconnected motor coupling. If motor is defective, replace it.

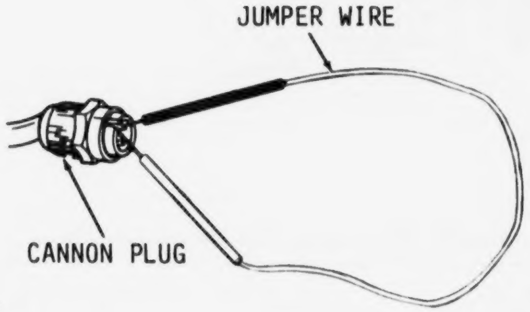

CANNON PLUG
PRESSURE SWITCH

4 Check for defective pressure switch.

Remove cannon plug from top of pressure switch. Connect multimeter leads to terminals A and B of pressure switch.



END VIEW OF CANNON PLUG

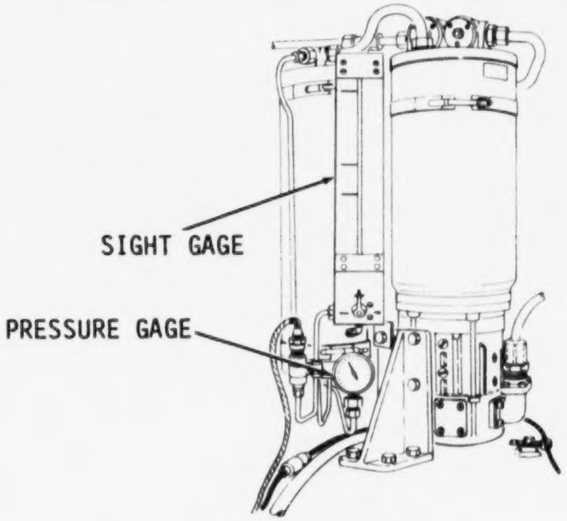

JUMPER WIRE
CANNON PLUG

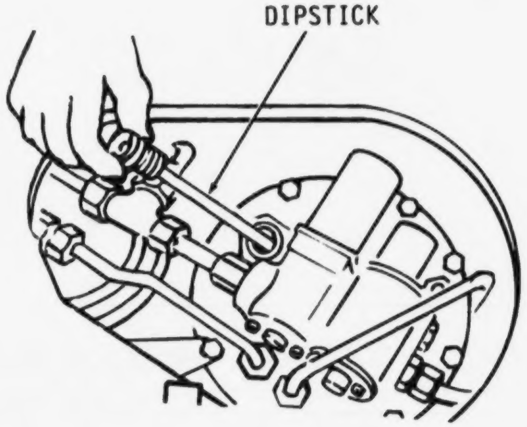
Jump from female plug A to female plug B of pressure switch cannon plug.

4 Check for defective pressure switch-Continued

Select ohms function of multimeter. Simultaneously observe pressure gage on main accumulator and ohms scale on multimeter. With pressure at 875 to 975 psi (6033-6722 kPa), pressure switch should be closed and ohms scale should read zero. When pressure rises to 1175 to 1275 psi (8101-8791 kPa), pressure switch should open and ohms scale will indicate infinity. Replace pressure switch if these readings are not obtained (ref. TM 9-2350-311-20-2).

SYSTEM WILL NOT DEVELOP FULL OPERATING PRESSURE AND POWERPACK MOTOR OPERATES CONTINUOUSLY.





1 Check for lack of hydraulic fluid in reservoir.

Look at sight gage and dipstick. Refill reservoir if level of fluid is low (ref. TM 9-2350-311-20-2).

2 Check nitrogen pressure in powerpack accumulator.

Discharge system and note pressure. Recharge nitrogen if pressure is below 500 psi (3447 kPa) (ref. page 5-58). Charge hydraulic system and check operation.

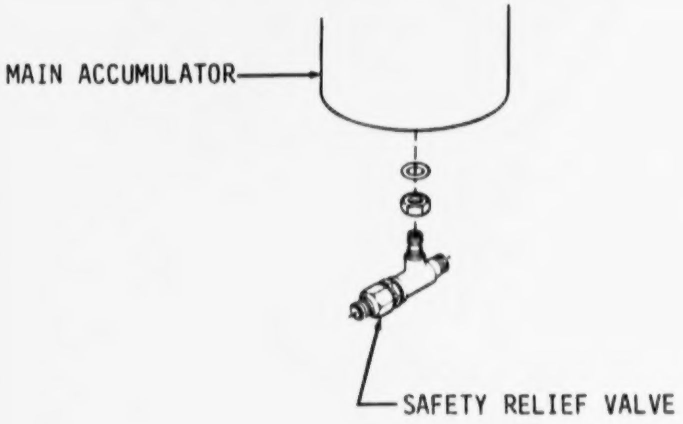
3 Check pressure switch.

Reference page 2-49.

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-29. POWERPACK AND HYDRAULICS -- Continued

SYSTEM WILL NOT DEVELOP FULL OPERATING PRESSURE AND POWERPACK MOTOR OPERATES CONTINUOUSLY.

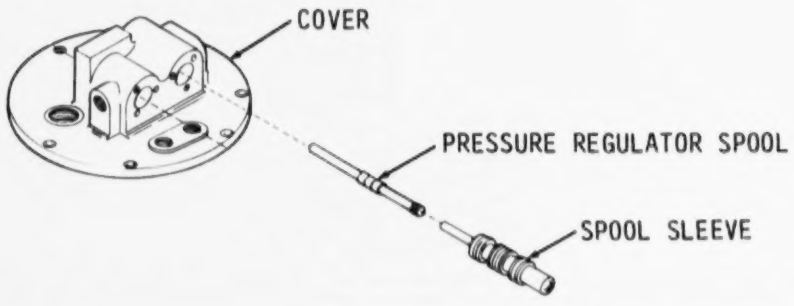

MAIN ACCUMULATOR
SAFETY RELIEF VALVE

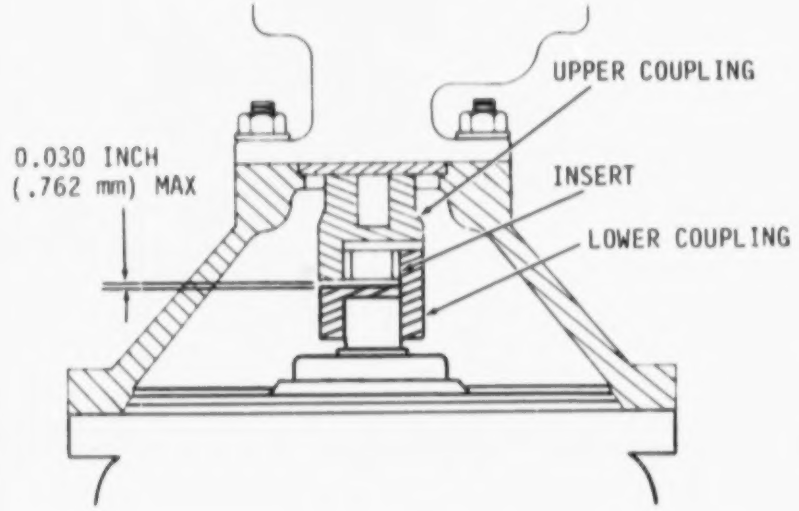
4 Check for faulty safety relief valve.

Discharge and drain hydraulic system (ref. TM 9-2350-311-20-2).

Remove safety relief valve from accumulator (ref. page 5-49). Replace safety valve if faulty (ref. pages 5-1 thru 5-29). Replace regulating spool or spool spring if faulty.

5 Check for faulty pressure regulating spool or spool spring.


COVER
PRESSURE REGULATOR SPOOL
SPOOL SLEEVE



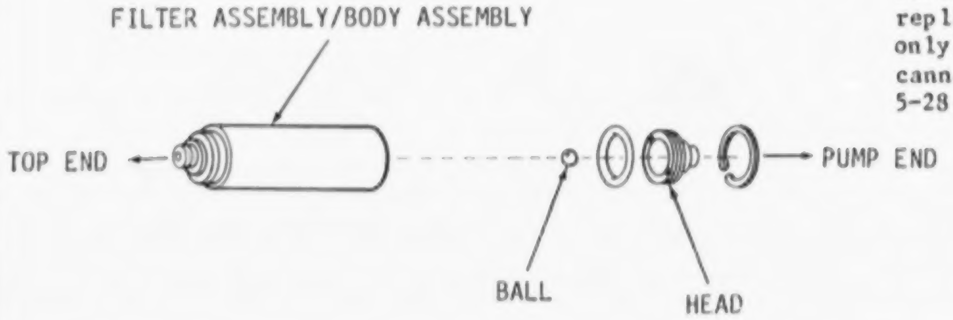
UPPER COUPLING
0.030 INCH
(.762 mm) MAX
INSERT
LOWER COUPLING

6 Check for slipping upper and lower couplings.

Adjust and tighten setscrews as required to eliminate slippage. Setscrews should be tightened only enough to provide 0.03 inch (.762 mm) clearance, at room temperature, between six-pointed insert and lower coupling (ref. page 5-111).

7 Check for jammed ball check valve in filter assembly/body assembly.

Disassemble filter assembly, clean parts, replace filter element (M109A2/M109A3 only), and assemble. Be sure ball bearing cannot jam in head (ref. page 5-26 or 5-28.2).

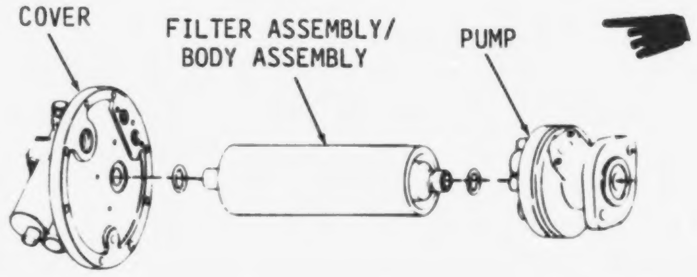


FILTER ASSEMBLY/BODY ASSEMBLY
TOP END
PUMP END
BALL
HEAD

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-29. POWERPACK AND HYDRAULICS – Continued

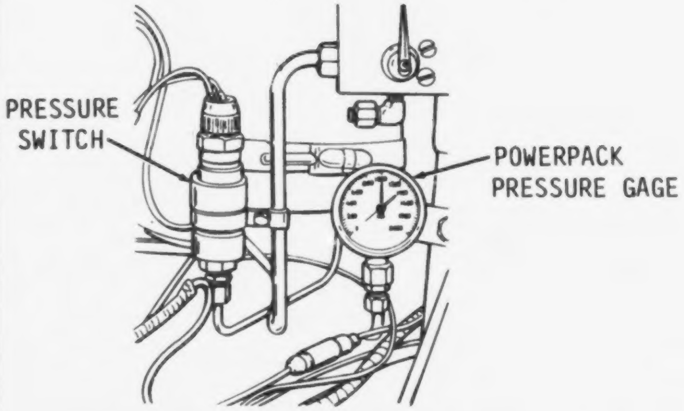
SYSTEM WILL NOT DEVELOP FULL OPERATING PRESSURE AND POWERPACK MOTOR OPERATES CONTINUOUSLY.


COVER
FILTER ASSEMBLY/
BODY ASSEMBLY
PUMP

8 Check for damaged or faulty pump.

If pump is damaged or faulty, replace pump (ref. page 5-9).

SYSTEM OVERCHARGES.


PRESSURE
SWITCH
POWERPACK
PRESSURE GAGE

1 Check for faulty or improperly set pressure switch.

Replace pressure switch (ref. TM 9-2350-311-20-2).

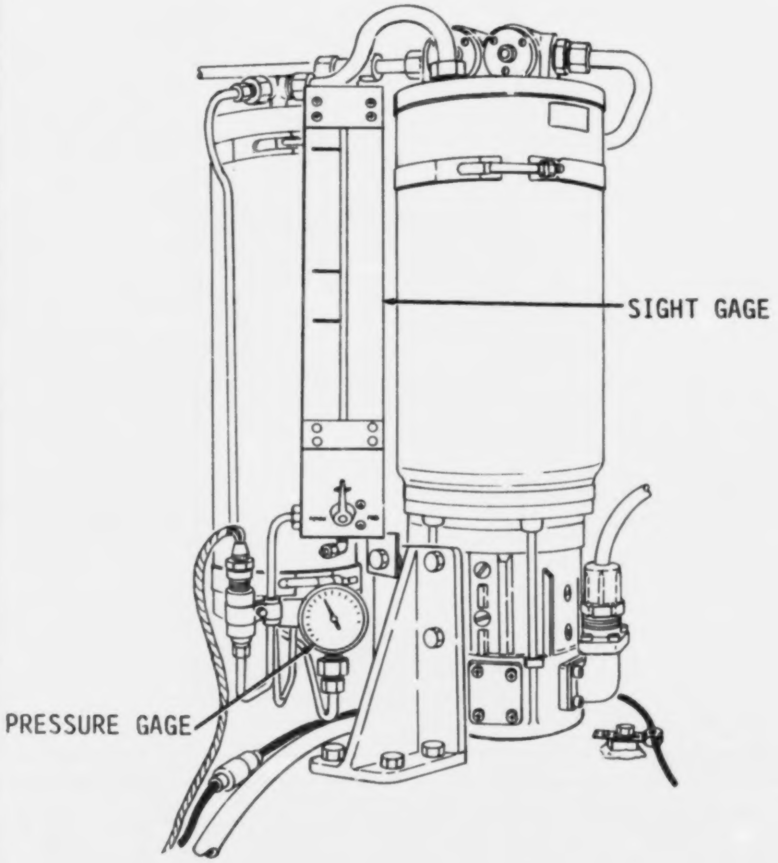
2 Check for faulty power relay.

Troubleshoot operation of power relay (ref. TM 9-2350-311-20-2).

3 Check for faulty pressure gage.

Compare pressure gage to a gage of known standard. Replace gage if it deviates from standard gage (ref. TM 9-2350-311-20-2).

OVERFLOW OF FLUID THROUGH FILLER CAP.



NOTE

Vehicle should be on level surface before checking fluid levels.

1 Check for high fluid level.

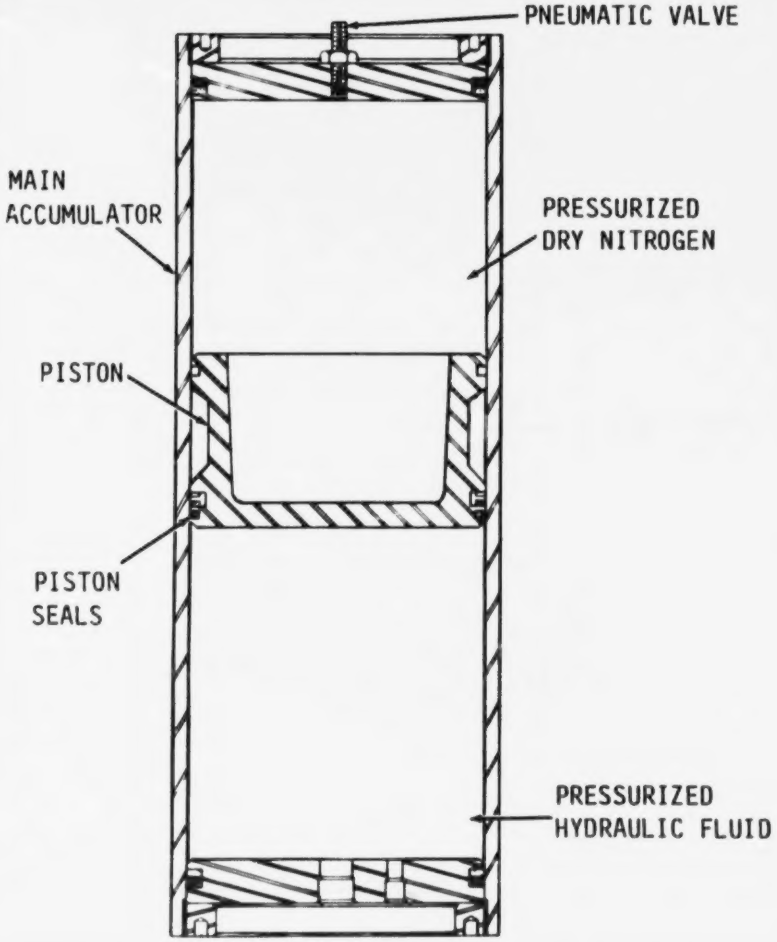
When powerpack electric drive motor has stopped after pumping, check powerpack reservoir fluid level. If fluid level is over FULL mark, drain fluid in reservoir (ref. TM 9-2350-311-20-1).

2 Check for low nitrogen pressure in main accumulator.

Charge with dry nitrogen, if required (ref. page 5-58).

2-29. POWERPACK AND HYDRAULICS – Continued

MAIN ACCUMULATOR WILL NOT HOLD DRY NITROGEN CHARGE.


PNEUMATIC VALVE
MAIN ACCUMULATOR
PRESSURIZED DRY NITROGEN
PISTON
PISTON SEALS
PRESSURIZED HYDRAULIC FLUID

1 Check for faulty pneumatic valve core.

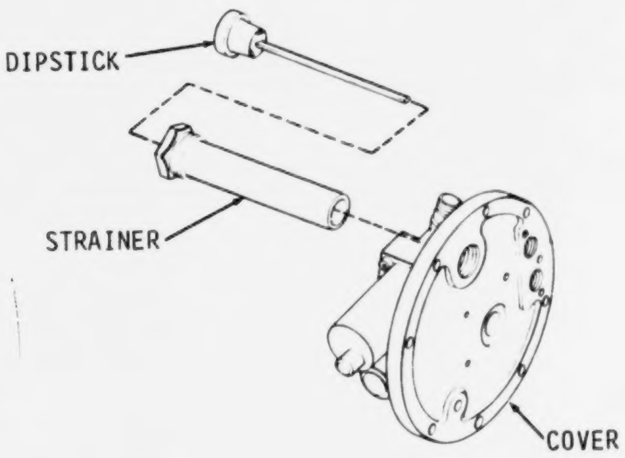
Apply a solution of water and soap to the pneumatic valve core to detect leaks. There must be no air bubbles present. If necessary, replace pneumatic valve core (ref. page 5-55).

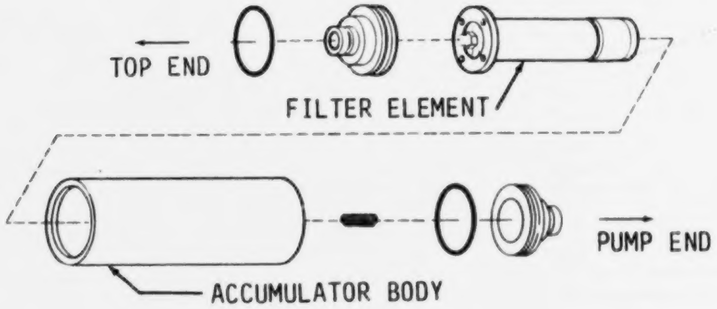
2 Check for internal leak in main accumulator.

Disassemble accumulator and repair. Be sure to replace piston seals (ref. page 5-52).

2-30. GUNNER'S CONTROLS

HANDLE DOES NOT RETURN TO NEUTRAL POSITION WHEN RELEASED.





1 Check for foreign matter in hydraulic fluid causing spools to bind.

Inspect hydraulic reservoir strainer for indications of contamination or foreign matter. Clean strainer (ref. TM 9-2350-311-20-2). Drain hydraulic system and discard fluid. Refill powerpack with new fluid and charge system (ref. TM 9-2350-311-20-2). Exercise gunner's or assistant gunner's control handle to make sure obstruction has been removed

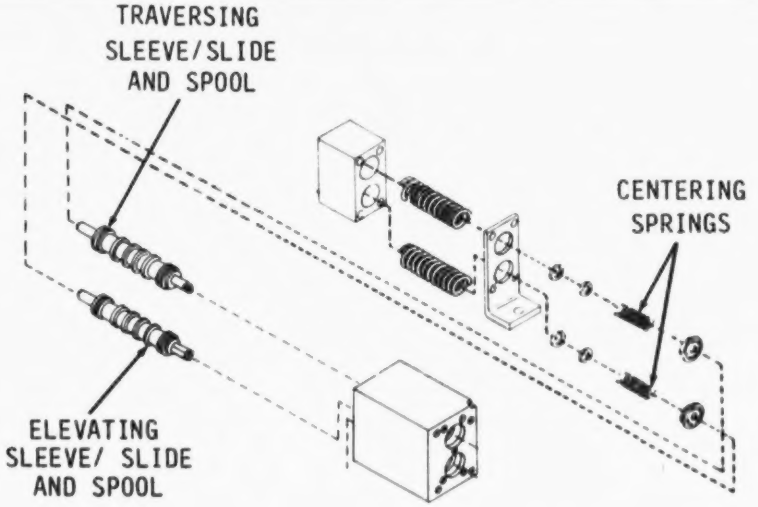
2 Check powerpack internal filter element of M109A2/M109A3 howitzer.

If handle is still not working properly, remove powerpack and disassemble (ref. page 5-2). Check filter element for contamination or foreign matter. Clean and replace as required. Install filter element, assemble and install powerpack, and fill and charge hydraulic system (ref. TM 9-2350-311-20-2 for filling and charging hydraulic system). Test control handle; if malfunction is still present, proceed to step 3 below.

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-30. GUNNER'S CONTROLS – Continued

HANDLE DOES NOT RETURN TO NEUTRAL POSITION WHEN RELEASED.


TRAVERSING SLEEVE/SLIDE AND SPOOL
CENTERING SPRINGS
ELEVATING SLEEVE/ SLIDE AND SPOOL

3 Check for faulty control.

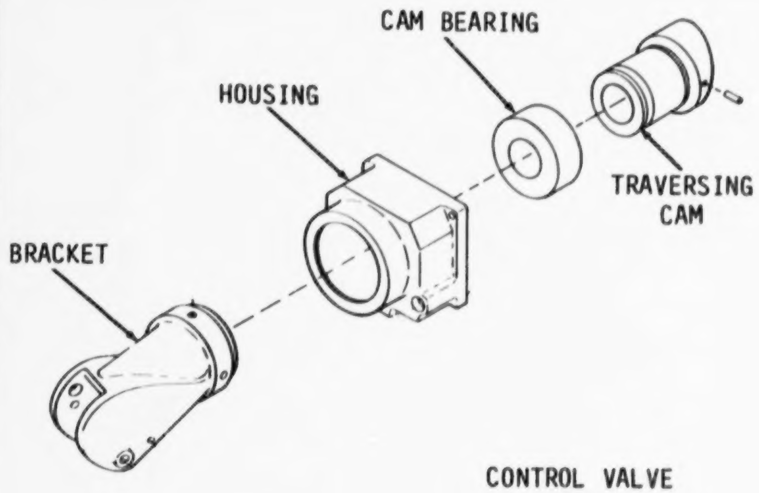
Remove control and disassemble. Look for faulty traversing and/or elevating spools or centering springs, or damaged spring pins. Repair or replace faulty parts as required (ref. pages 5-156, 5-160 and 5-190 thru 5-208).

HANDLE INOPERATIVE AFTER REBUILD.

Check position of traversing spool.

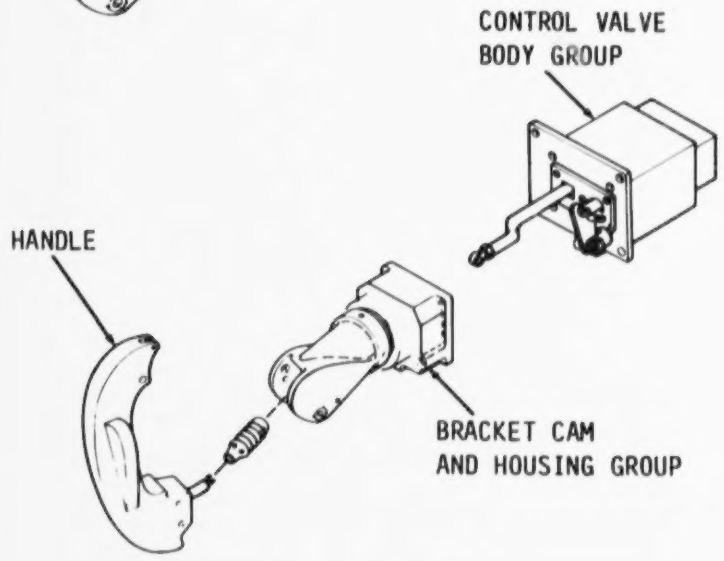
If traversing spool is 180 degrees out of position, handle will not function. Remove and disassemble control and turn spool around end-for-end (ref. page 5-196).

HANDLE BINDS WHEN TRAVERSING.


CAM BEARING
HOUSING
TRAVERSING CAM
BRACKET

1 Check for defective traversing cam bearing.

Remove gunner's control (left) and disassemble. Replace cam roller bearing (ref. pages 5-160 and 5-192).

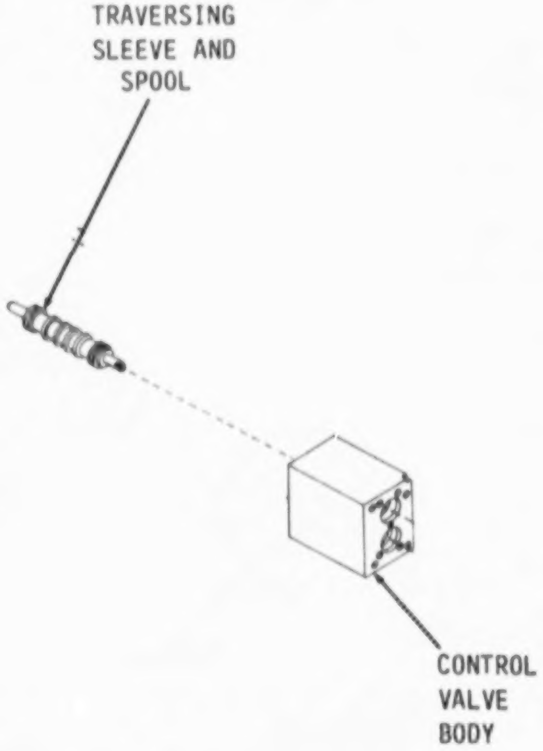

CONTROL VALVE BODY GROUP
HANDLE
BRACKET CAM AND HOUSING GROUP

2 Check for improperly assembled handle.

Replace handle (ref. page 5-190).

2-30. GUNNER'S CONTROLS – Continued

HANDLE BINDS WHEN TRAVERSING.

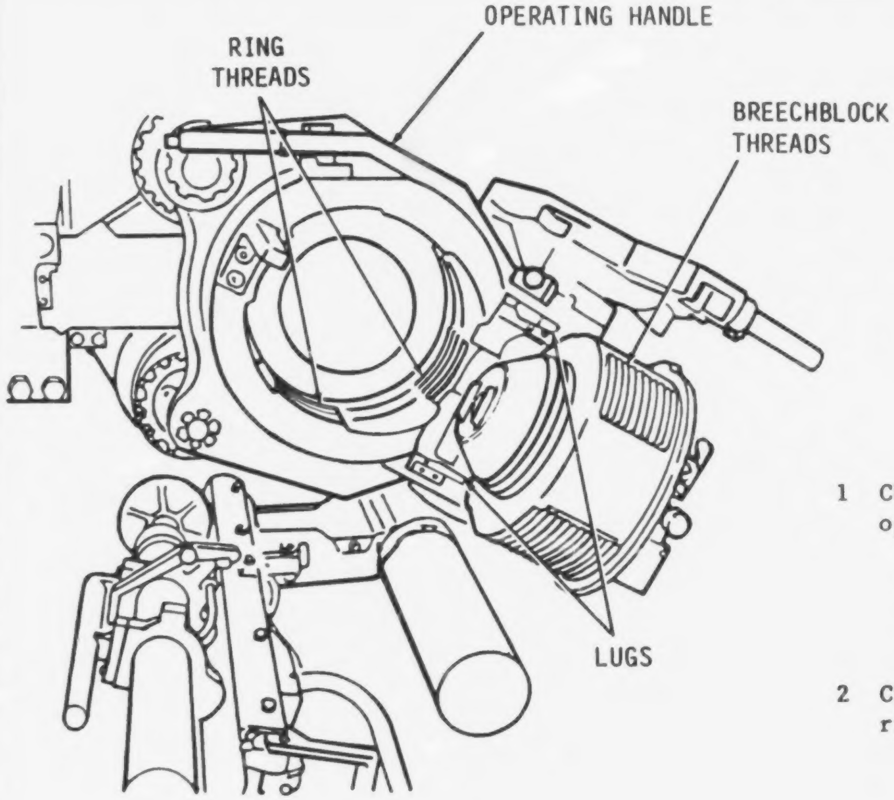

TRAVERSING SLEEVE AND SPOOL
CONTROL VALVE BODY

3 Check for traversing sleeve and valve spool failure.

Repair control (ref. page 5-196).

2-31. CANNON M185

BREECH MECHANISM DOES NOT OPERATE FREELY.



WARNING

Personnel should wear steel-tipped safety shoes and safety glasses to avoid possible injury.

1 Check for smooth operation of breech operating handle.

Open breech and move handle back and forth to check for binding. Repair or replace handle.

2 Check for dirty threads on breechblock or ring.

Clean threads.

3 Check for sufficient lubrication.

Lubricate breech mechanism in accordance with LO 9-2350-311-12.

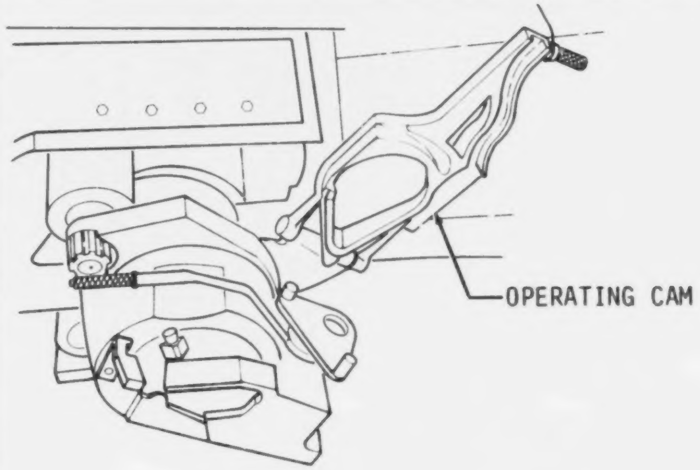
4 Check for damaged breechblock (ref. page 4-120.

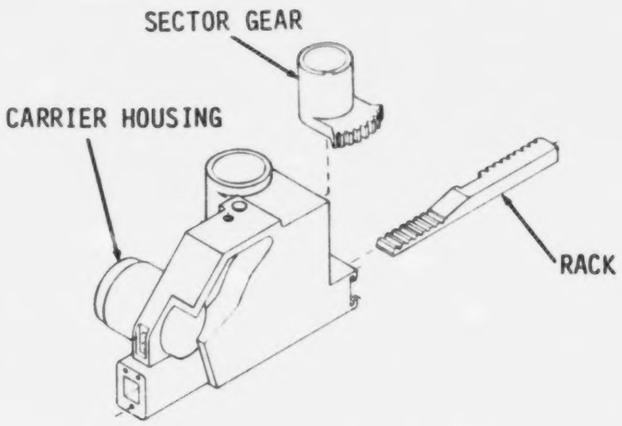
2-31. CANNON M185 – Continued

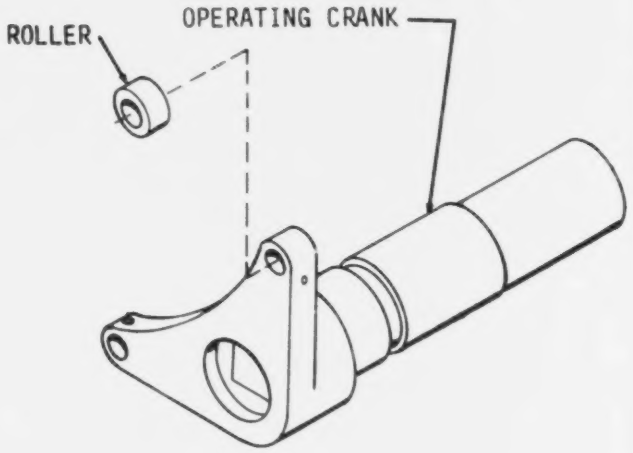
BREECH MECHANISM DOES NOT OPERATE FREELY.

5 Check for damaged threads on breech ring and damaged cam. Check crank for damaged rollers, damaged breechblock , sector gear, or rack.

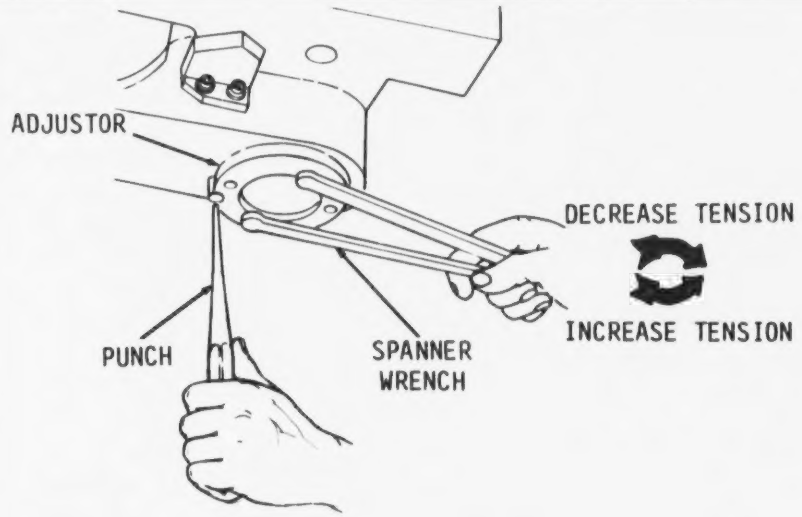
Disassemble, clean, examine parts for wear or breakage. Repair or replace defective parts.


OPERATING CAM


SECTOR GEAR
CARRIER HOUSING
RACK

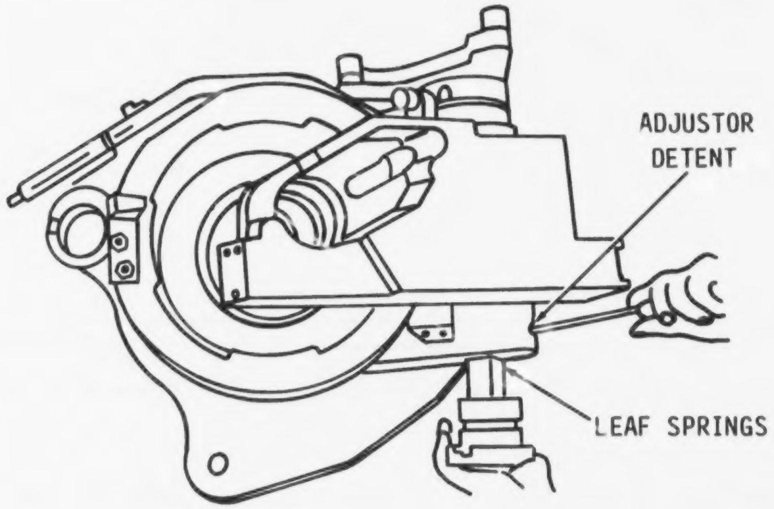

ROLLER
OPERATING CRANK

BREECHBLOCK DOES NOT CLOSE COMPLETELY.


ADJUSTOR
DECREASE TENSION
INCREASE TENSION
PUNCH
SPANNER WRENCH

1 Check for proper adjustment of closing springs.

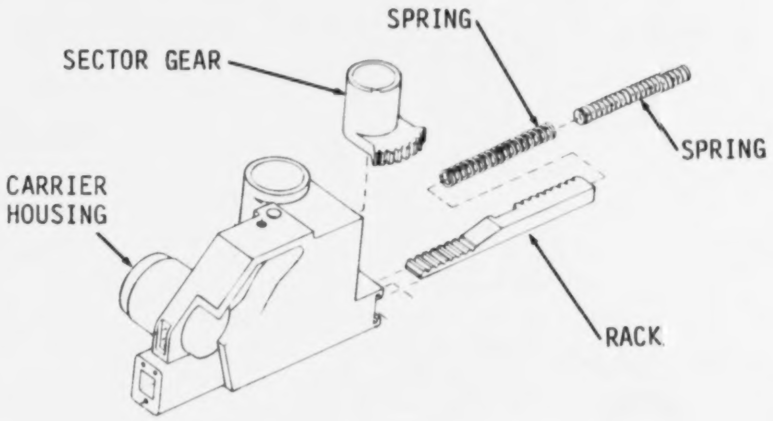
Adjust closing springs (ref. page 4-96).


ADJUSTOR DETENT
LEAF SPRINGS

2 Check for damaged leaf springs.

Disassemble, clean and examine parts for wear or breakage. Repair or replace defective parts (ref. page 4-96).

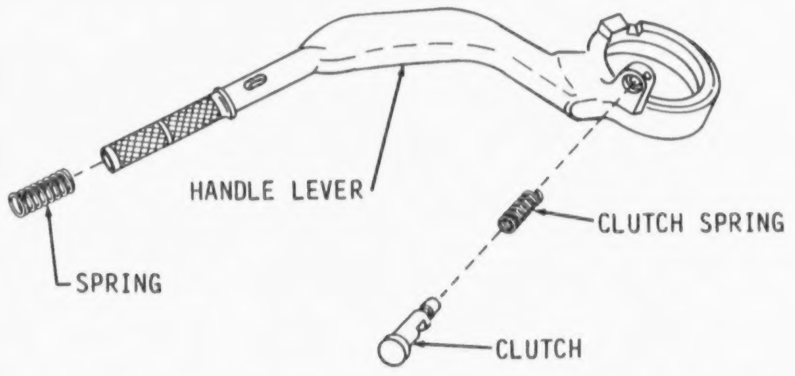
2-31. CANNON M185 — Continued BREECHBLOCK DOES NOT CLOSE COMPLETELY.


SPRING
SECTOR GEAR
SPRING
CARRIER HOUSING
RACK

3 Check for damaged operating rack springs, defective sector gear or rack.

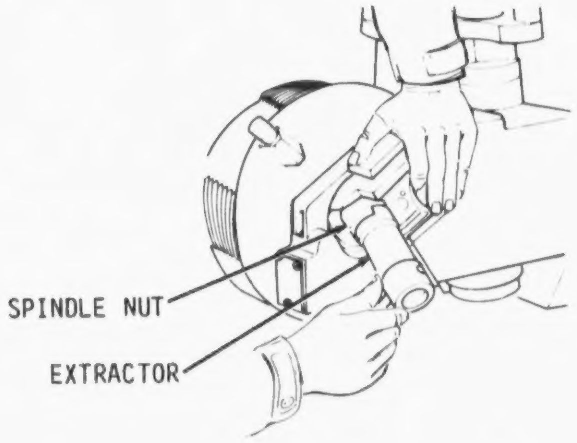
Disassemble, clean and examine parts for wear or breakage. Repair or replace defective parts (ref. page 4-96).

BREECH MECHANISM WILL NOT OPEN MANUALLY.


HANDLE LEVER
CLUTCH SPRING
SPRING
CLUTCH

1 Check for defective operating handle.

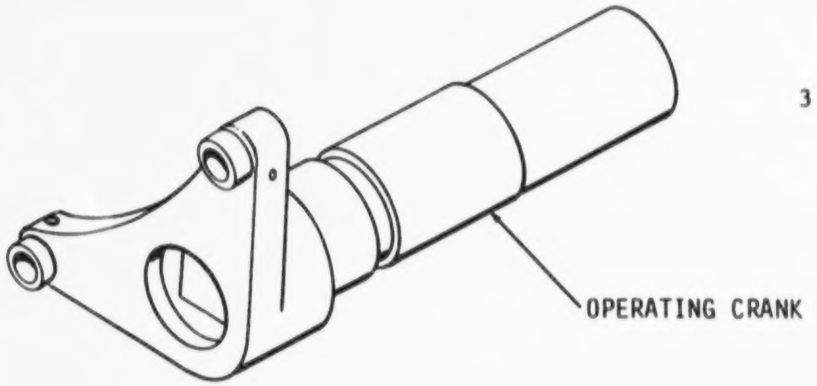
Replace or repair operating handle (ref. page 4-133).


SPINDLE NUT
EXTRACTOR

2 Check for loose obturator spindle nut.

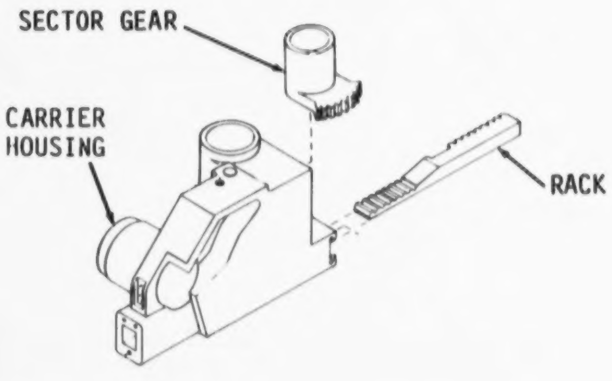
Tighten obturator spindle nut (ref. page 4-96).

BREECH MECHANISM WILL NOT OPEN MANUALLY.


OPERATING CRANK

3 Check for defective operating crank.

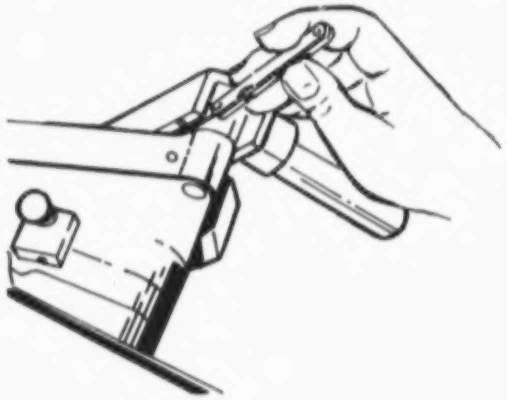
Disassemble and replace defective parts (ref. page 4-122).


SECTOR GEAR
CARRIER HOUSING
RACK

4 Check for defective sector gear or rack.

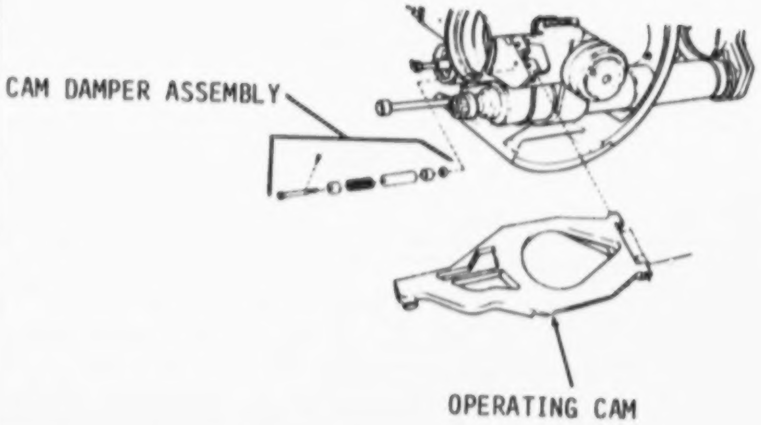
Disassemble and replace defective parts (ref. page 4-124).

BREECH MECHANISM WILL NOT OPEN AUTOMATICALLY AFTER FIRING.



1 Check for improper clearance between operating crank roller and breech operating cam.

Adjust breech operating cam to proper clearance (ref. TM 9-2350-311-20-2).



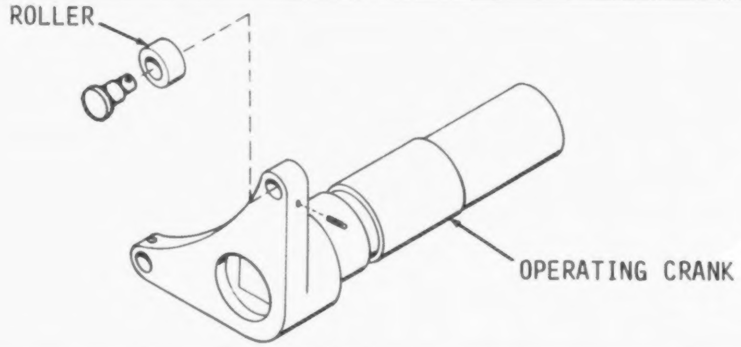
2 Check for defective damper assembly.

Repair or replace damper assembly (ref. page 4-135).

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-31. CANNON M185 – Continued

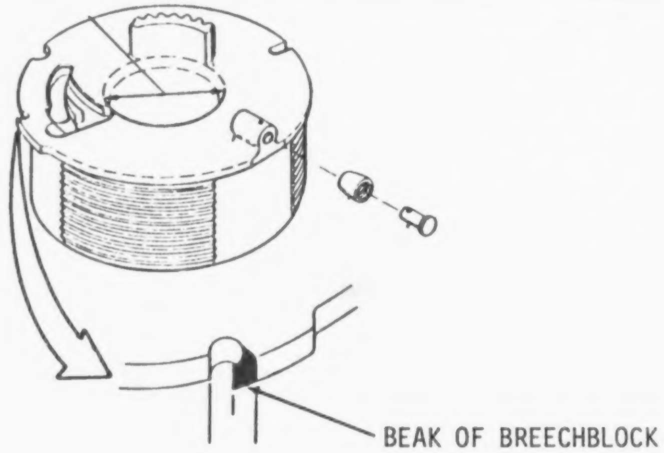
BREECH MECHANISM WILL NOT OPEN AUTOMATICALLY AFTER FIRING. - Continued



3 Check for broken breech operating crank roller.

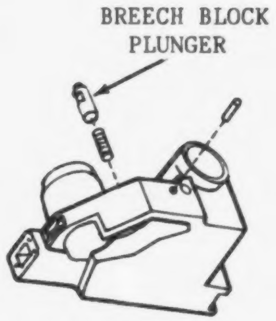
Replace roller (ref. page 4-122).

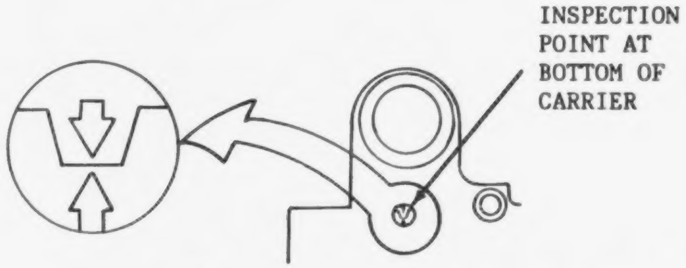
OVERROTATION OR JAMMED BREECHBLOCK.

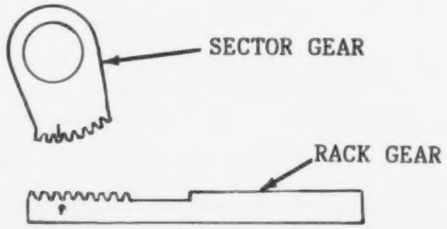


1 Check threads of breechblock for burrs or damage. Remove burrs.

2 Check beak of breechblock for wear, (ref. page 4-121). Replace breechblock.


BREECH BLOCK PLUNGER


INSPECTION POINT AT BOTTOM OF CARRIER


SECTOR GEAR
RACK GEAR

3 Check breechblock plunger for wear (ref. page 4-128).

Replace plunger.

4 Check breechblock gear. Sector gear and rack gears for excessive backlash (ref. page 4-128).

Replace defective parts.

5 Check rack gear and sector gear for proper timing alinement (ref. 4-129).

Properly aline gears.

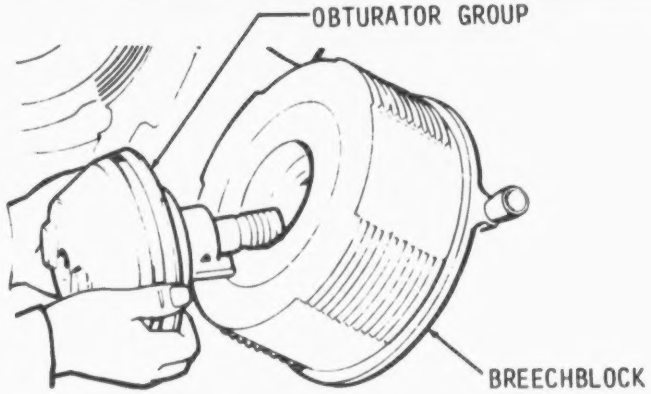
6 Check alinement of breechblock gears and rack gear with breechblock plunger (ref. TM 9-2350-311-10).

Properly aline gears.

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-31. CANNON M185 – Continued

GASES ACCUMULATE IN CAB AFTER FIRING.



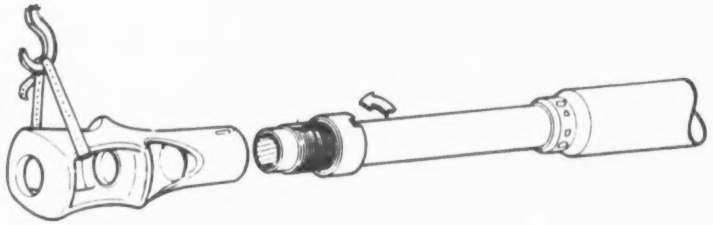
1 Check for dirty evacuator ball valves.

Clean, inspect, & replace ball valves and valve ring as necessary (ref. page 4-76).

2 Check for defective obturator group.

Repair or replace obturator group (ref. page 4-96).

EXCESSIVE RECOIL FORCE.



1 Check for defectve muzzle brake.

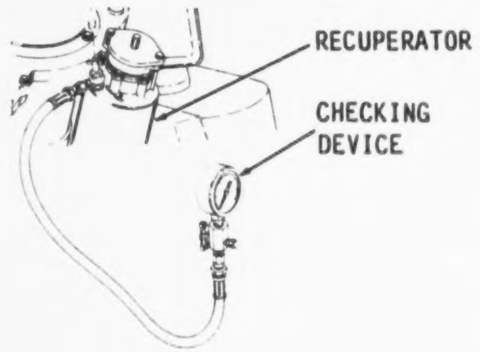
Replace muzzle brake (ref. page 4-72).

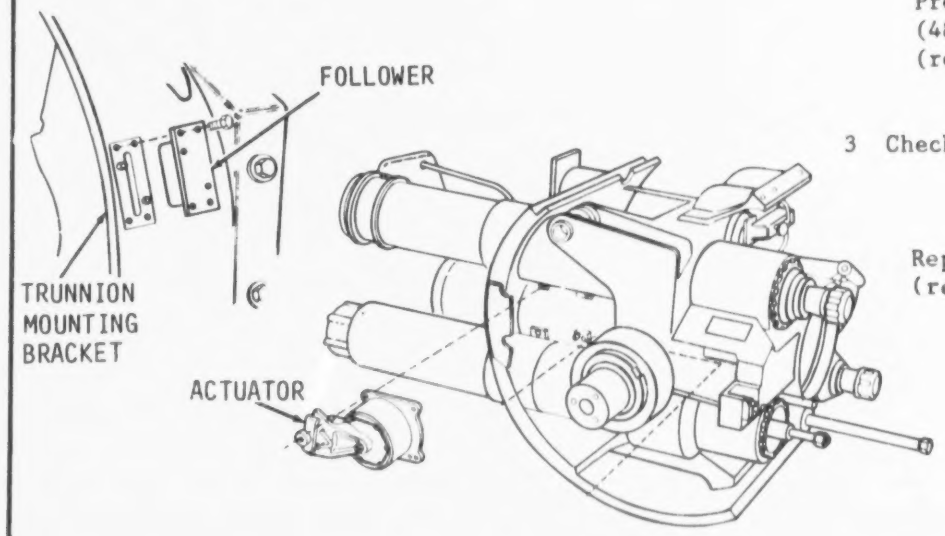
2 Check for insufficient fluid or air in variable recoil assembly.

Replenish as required (ref. TM 9-2350-303-10).

2-32. MOUNT M178

INSUFFICIENT RECOIL TRAVEL.


RECUPERATOR
CHECKING DEVICE


FOLLOWER
TRUNNION MOUNTING BRACKET
ACTUATOR

CAUTION

Cannon is shown elevated only for clarification. Cannon must be at zero elevation when checking or charging recuperator cylinder.

1 Check for hydraulic fluid in recuperator (ref. page 4-168).

2 Check for low nitrogen pressure in recuperator.

Pressure in recuperator should be 700 psi (4826 kPa). Repressurize as required (ref. page 4-146).

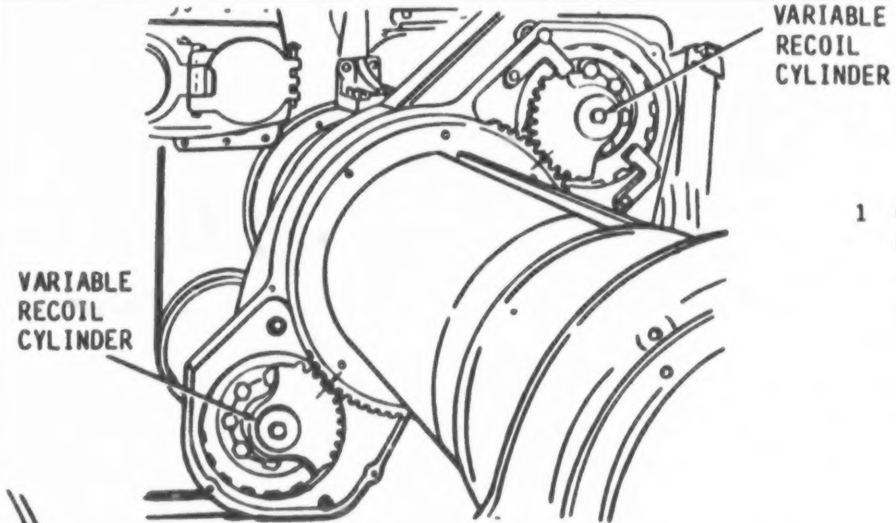
3 Check follower and actuator operations.

Repair or replace faulty parts as required (ref. page 4-219).

GENERAL CAB MAINT - SECTION V-TROUBLESHOOTING — Continued

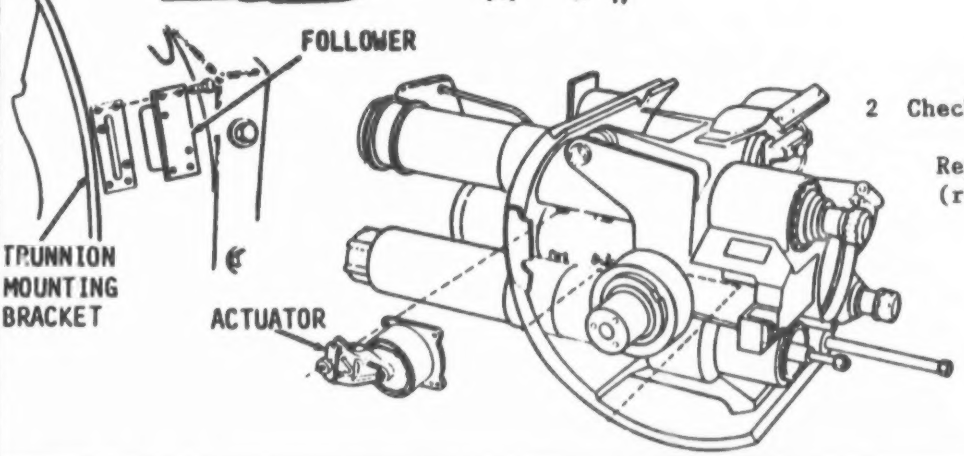
2-32. MOUNT M178 — Continued

INSUFFICIENT RECOIL TRAVEL.


VARIABLE RECOIL CYLINDER
VARIABLE RECOIL CYLINDER

1 Check for malfunction in variable recoil cylinders.

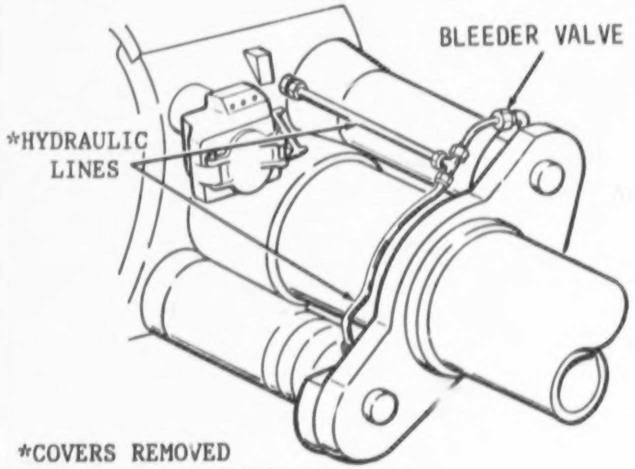
Remove, disassemble and inspect variable recoil cylinders (ref. page 4-180).


FOLLOWER
TRUNNION MOUNTING BRACKET
ACTUATOR

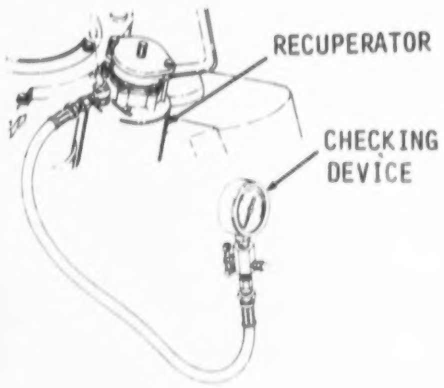
2 Check follower and actuator operation.

Repair or replace faulty parts as required (ref. page 4-219).

CANNON DOES NOT RETURN TO BATTERY.



*COVERS REMOVED FOR CLARIFICATION



1 Check for leaks and obstructions in mount hydraulic system.

Tighten loose connections and replace defective hydraulic tubes (ref. TM 9-2350-311-20-2).

CAUTION

Cannon is shown elevated only for clarification. Cannon must be at zero elevation when checking or charging recuperator cylinder.

2 Check for low nitrogen pressure in recuperator.

Pressure in recuperator should be 700 psi (4826 kPa). Repressurize as required (ref. page 4-146).

3 check for defective recuperator.

Repair recuperator (ref. page 4-146).

4 Check for defective variable recoil cylinders.

Repair variable recoil cylinders (ref. page 4-180).

GENERAL CAB MAINTENANCE – Section V. Troubleshooting–Continued

2-32. MOUNT M178 – Continued

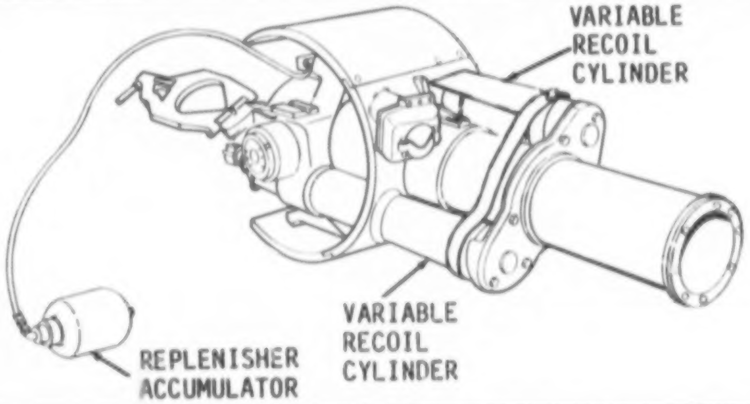
CANNON RETURNS TO BATTERY WITH EXCESSIVE FORCE.

1 Check for excessively high recuperator pressure.

2 Check for air or low fluid level in replenisher system.

Bleed and add fluid to replenisher system as necessary (ref. TM 9-2350-311-10).

INSUFFICIENT HYDRAULIC PRESSURE IN VARIABLE RECOIL CYLINDER.

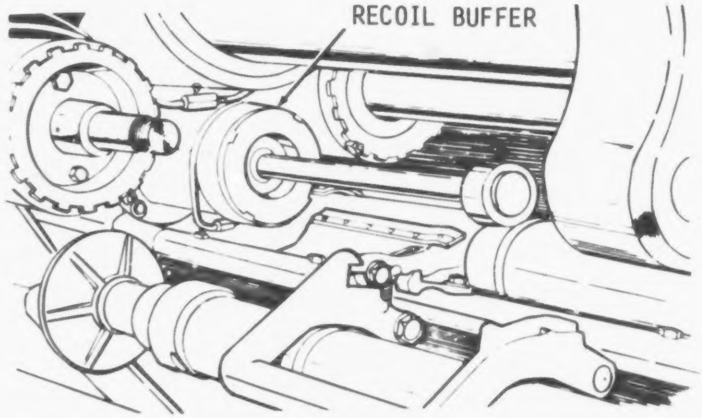

VARIABLE RECOIL CYLINDER
VARIABLE RECOIL CYLINDER
REPLENISHER ACCUMULATOR

1 Check for defective replenisher accumulator.

Repair or replace replenisher accumulator (ref. page 4-242).

2 Check for defective variable recoil cylinders.

Remove, disassemble and inspect variable recoil cylinders.

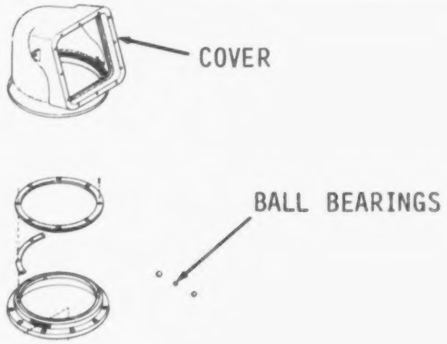


3 Check for defective recoil buffer.

Repair or replace recoil buffer (ref. page 4-208).

2.33 PANORAMIC TELESCOPE BALLISTICS COVER

EXTREME EFFORT REQUIRED TO TRAVERSE COVER.



Check for damaged phenolic rosin ball bearings.

Clean and lubricate ball bearings. Replace any damaged ball bearings (ref. page 13-1).

CHAPTER 3 CAB AND BEARING ASSEMBLY RACE RING

GENERAL

This chapter illustrates and describes removal and installation of CAB and removal, disassembly, inspection and repair, assembly and installation of bearing assembly race ring. These procedures are functions authorized for direct and general support level maintenance

Title		Page
3-1.	CAB	3-2
3-2.	BEARING ASSEMBLY RACE RING	3-14

CAB AND BEARING ASSEMBLY RACE RING — Continued

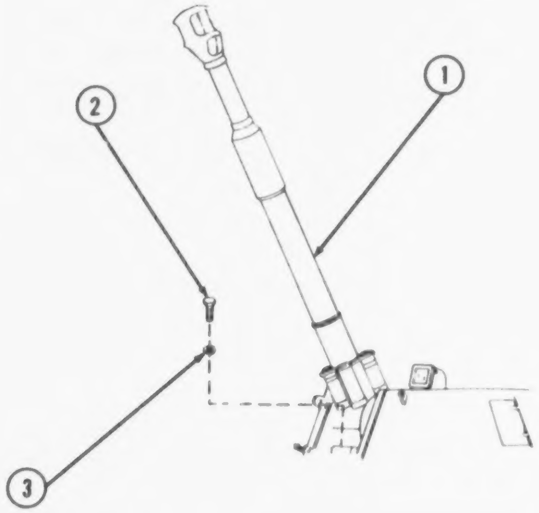
3-1. CAB

This task covers:

a. Removal b. Installation

INITAL SET-UP Materials/Parts Lock washers	Special Tools Hoist, cab lifting (Item 2, App. B) Fabricated cab stand (App. E) Sling, cab lifting (Item 5, App. B) Sling assembly, traverse mechanism, lifting (Item 3, App. B)	Personnel Required 3

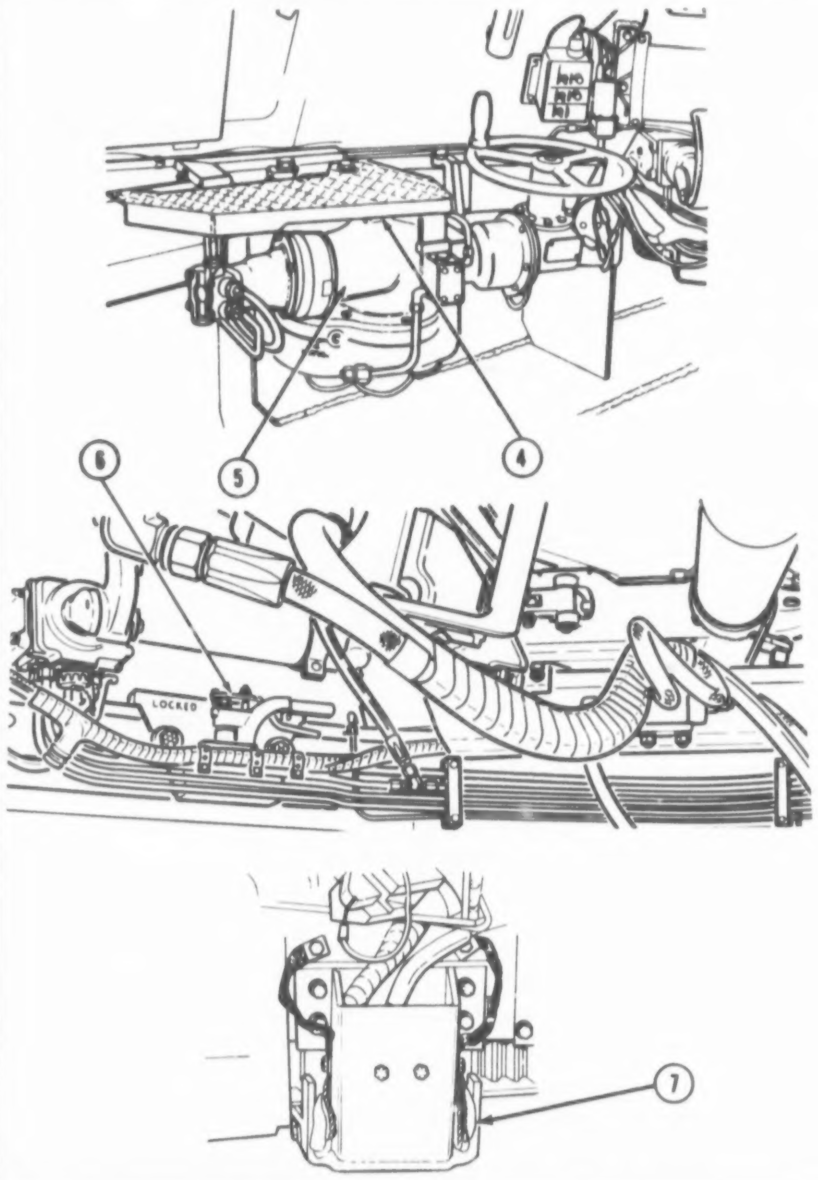
a. Removal



1 Elevate cannon assembly (1) to maximum elevation. Remove three bolts (2) and three flat washers (3) from bottom of trunnion support bracket outside cab. Depress cannon assembly (1) to maximum depression.

WARNING

- Make sure CAB POWER and MASTER switches are OFF (ref. TM 9-2350-311-10). Disconnect battery ground cable at battery terminal (ref. TM 9-2350-311-20-1). Failure to follow this procedure could result in serious burns or electrical shock.
- Vehicular movement could injure personnel. Make sure vehicle is parked on level ground.



2 Discharge and drain cab hydraulic system (ref. TM 9-2350-311-20-2).

3 Remove traversing mechanism step plate (4) (ref. page 9-17) and traversing mechanism (5) (ref. page 9-50).

4 **Remove turret lock (6) (ref. TM 9-2350-311-20-2).**

NOTE

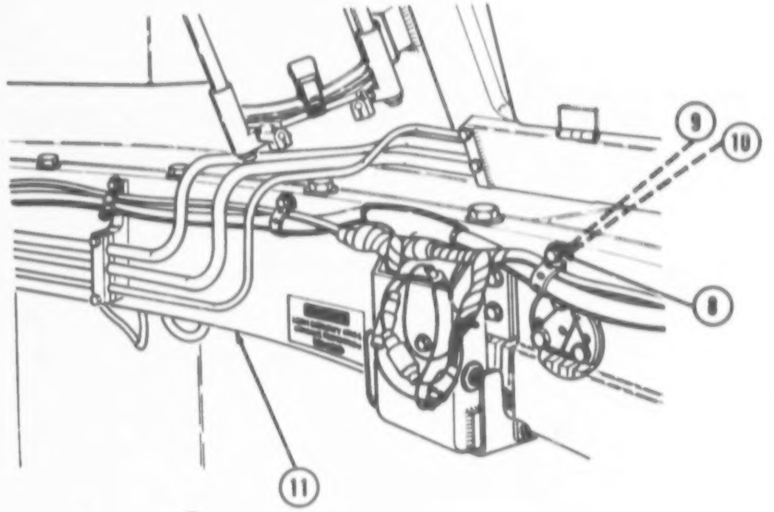
- **Do not disconnect electrical cables from electrical contact arm assemblies in step 5. Lay arm assemblies on top of cab ring plate. Secure arm assemblies with tape or lock wire.**
- Some vehicles have three electrical contact arm assemblies and some vehicles have five electrical contact arm assemblies.

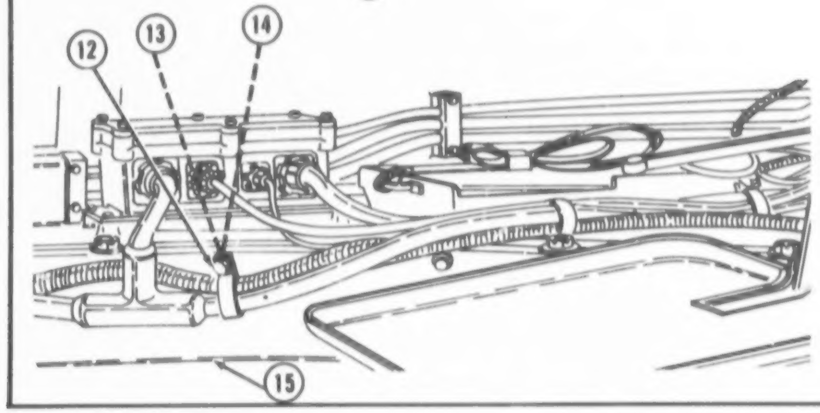
5 Remove electrical contact arm assemblies (7) (ref. TM 9-2350-311-20-2).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-1. CAB — Continued

a. Removal-Continued



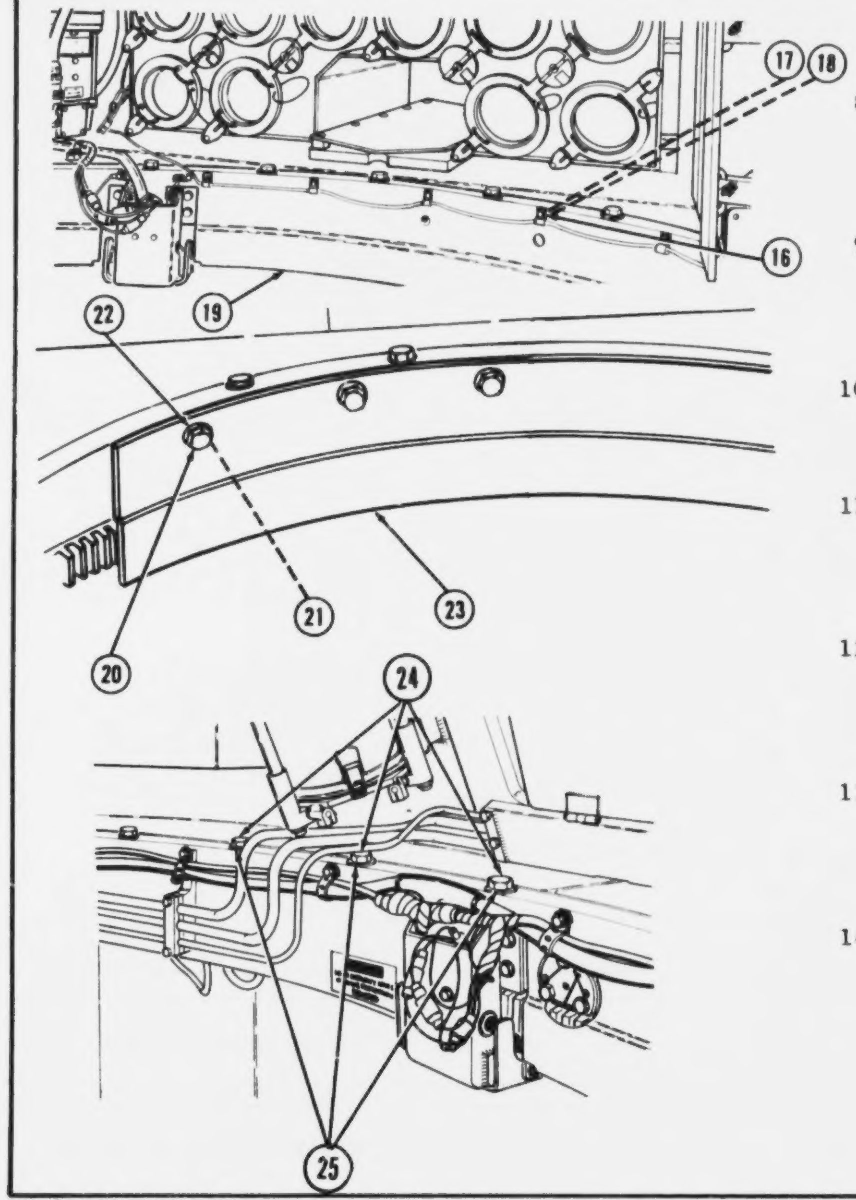


NOTE

Steps 6 thru 9 apply to early production vehicles with four bearing shields. Steps 10 thru 15 apply to later production vehicles with five bearing shields. Illustrations pertain to either steps 6 thru 9 or steps 10 thru 15.

6 Remove three screws (8), three lock washers (9), three flat washers (10) and right front shield (11). Discard three lock washers (9).

7 Remove seven screws (12), seven lock washers (13), seven flat washers (14) and right rear shield (15). Discard seven lock washers (13).



8 Remove seven screws (16), seven lock washers (17), seven flat washers (18) and left rear shield (19). Discard seven lock washers (17).

9 Remove three screws (20), three lock washers (21), three flat washers (22) and left front shield (23). Discard three lock washers (21).

10 Remove three screws (8), three lock washers (9), three flat washers (10) and right front shield (11). Discard three lock washers (9).

11 Remove seven screws (12), seven lock washers (13), seven flat washers (14) and right rear shield (15). Discard seven lock washers (13).

12 Remove seven screws (16), seven lock washers (17), seven flat washers (18) and left rear shield (19). Discard seven lock washers (17).

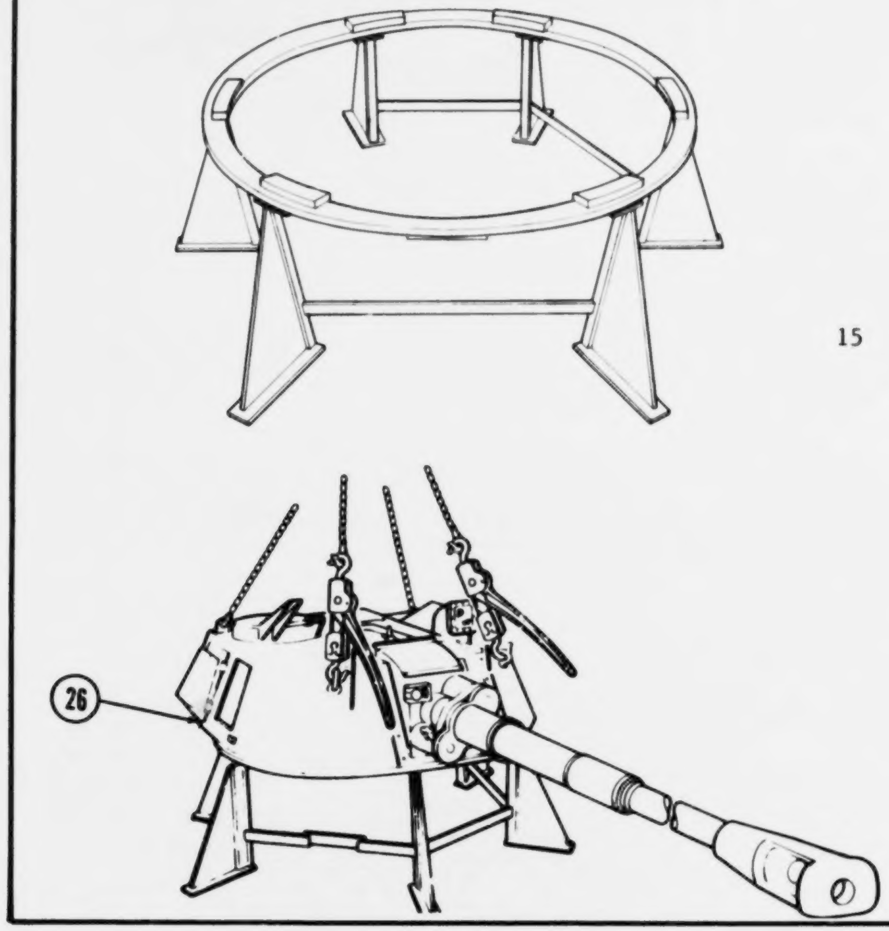
13 Remove three screws (20), three lock washers (21), three flat washers (22) and left front shield (23). Discard three lock washers (21). Repeat for right center shield.

14 Remove 29 bolts (24) and 29 flat washers (25).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-1. CAB — Continued

a. Removal-Continued



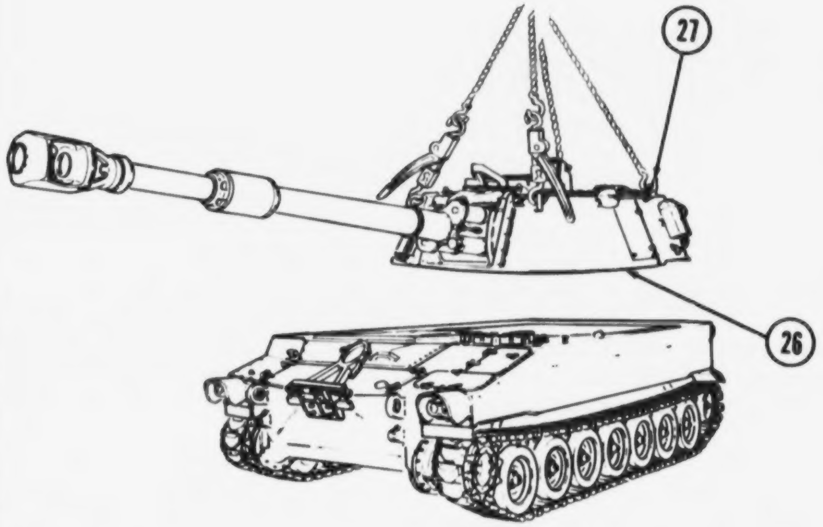
WARNING

Use a lifting device with a capacity of at least 15,000 pounds (6810 kilograms) to avoid possible injury or death. A lifting device with insufficient lifting capacity could break due to stress.

15 Position fabricated cab stand (App. E) adjacent to cab (26). Position two cab lifting hoists (Item 2, App. B) and cab lifting sling (Item 5, App. B) behind cab (26) and fabricated cab stand (App. E).

NOTE

Make sure cab lifting hoists are attached either to both forward or both aft lifting eyes. This procedure will allow adjustments for level attitude as cab is being lifted.



16 Attach two cab lifting hoists (Item 2, App. B) and cab lifting sling (Item 5, App. B) to four cab lifting eyes (27) as shown.

17 Raise cab (26) slowly and position on fabricated cab stand (App. E).

18 Detach two cab lifting hoists (Item 2, App. B) and cab lifting sling (Item 5, App. B).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-1. CAB — Continued

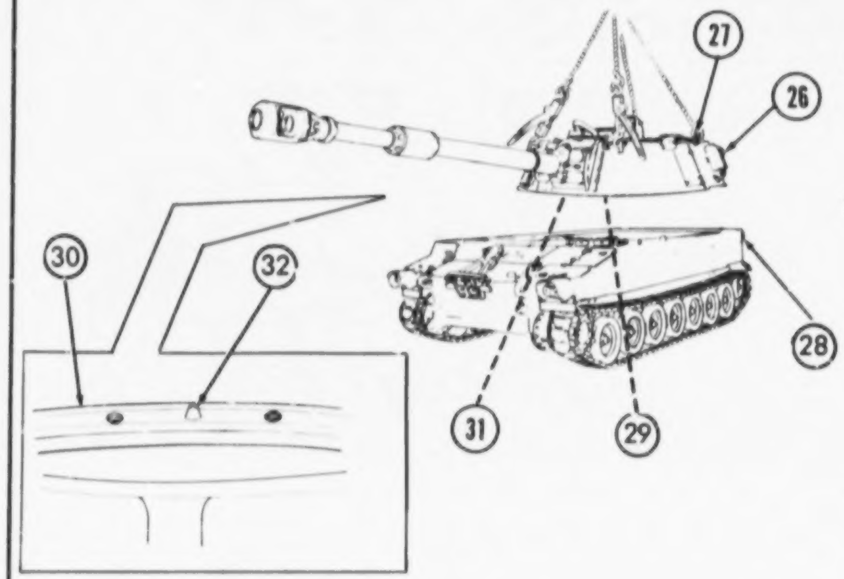
b. Installation

WARNING

- Make sure CAB POWER and MASTER switches are OFF (ref. TM 9-2350-311-10). Disconnect battery ground cable at battery terminal (ref. TM 9-2350-311-20-1). Failure to follow this procedure could result in serious burns or electrical shock.
- Vehicular movement could injure personnel. Make sure vehicle is parked on level ground.
- Use a lifting device with a capacity of at least 15,000 pounds (6810 kilograms) to avoid possible injury or death. A lifting device with insufficient lifting capacity could break due to stress.
- **Personnel should wear steel-tipped safety shoes and safety glasses to avoid possible injury.**

NOTE

Make sure cab lifting hoists are attached either to both forward or both aft lifting eyes. This procedure will allow adjustments for level attitude as cab is being lifted.



1 Attach two cab lifting hoists (Item 2, App. B) and cab lifting sling (Item 5, App. B) to four cab lifting eyes (27) as shown.

2 Raise cab (26) slowly and position over hull (28).

NOTE

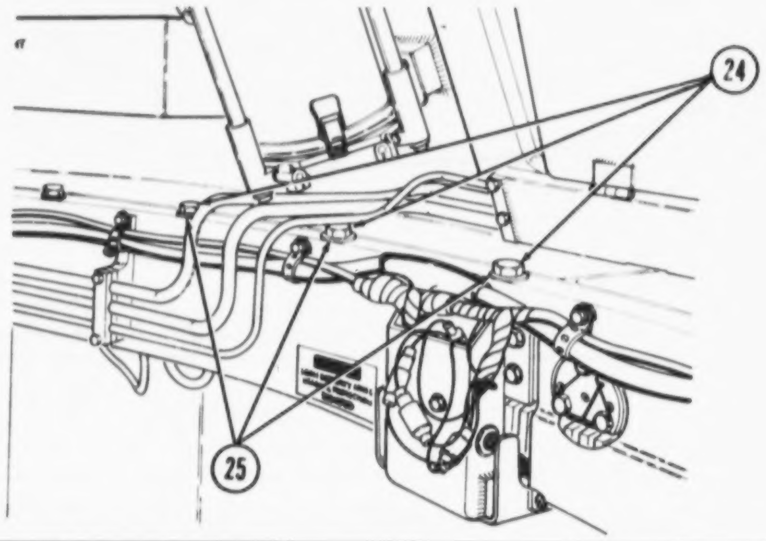
A guide rope may be used to aline race ring alining pins with alining holes on race ring.

3 Aline bolt holes (29) in cab (26) with race ring (30). Aline alining hole (31) with alining pin (32).

4 Lower cab (26) onto hull (28) slowly.

5 Detach cab lifting sling (Item 5, App. B) and two cab lifting hoists (Item 2, App. B) from four cab lifting eyes (27).

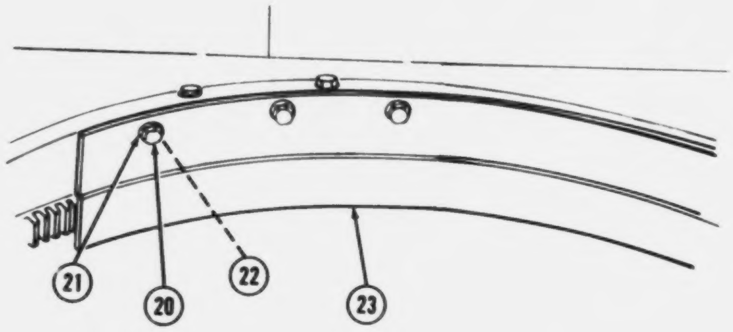
6 Install 29 flat washers (25) and 29 bolts (24). Torque to 248 to 302 ft-lbs.



CAB AND BEARING ASSEMBLY RACE RING — Continued

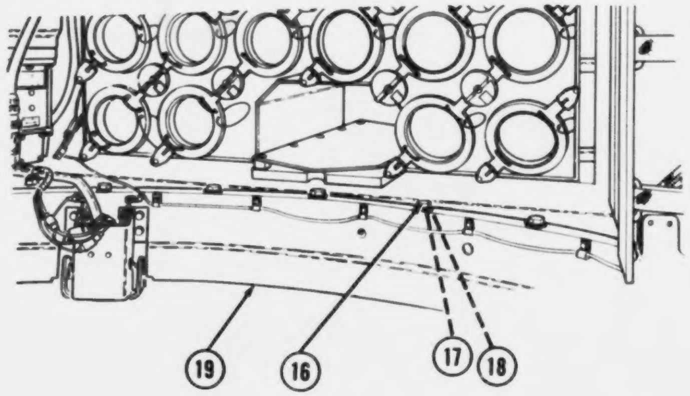
3-1. CAB — Continued

b. Installation-Continued



NOTE

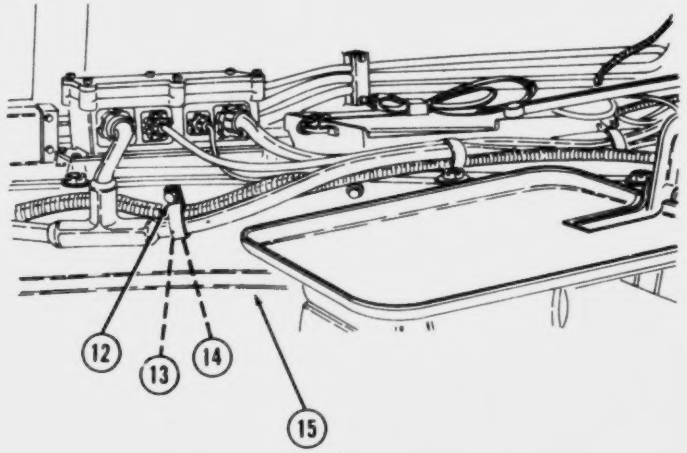
- Steps 7 thru 11 apply to later production vehicles with five bearing shields. Steps 12 thru 16 apply to earlier production vehicles with four bearing shields. Illustrations pertain to either steps 7 thru 11 or steps 12 thru 16.
- Install all shields upward.

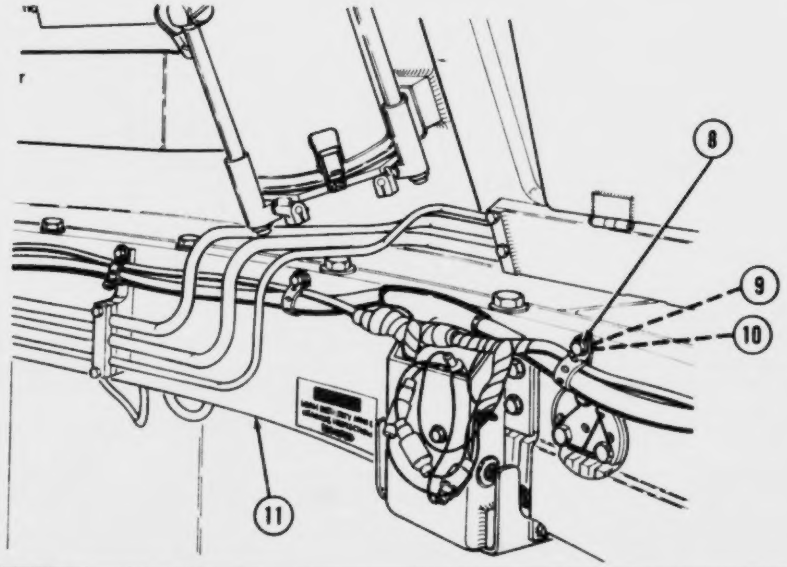


7 Install left front shield (23) using three flat washers (22), three new lock washers (21) and three screws (20).

8 Repeat for right center shield.

9 Install left rear shield (19) using seven flat washers (18), seven new lock washers (17) and seven screws (16).





10 Install right rear shield (15) using seven flat washers (14), seven new lock washers (13) and seven screws (12).

11 Install right front shield (11) using three flat washers (10), three new lock washers (9) and three screws (8).

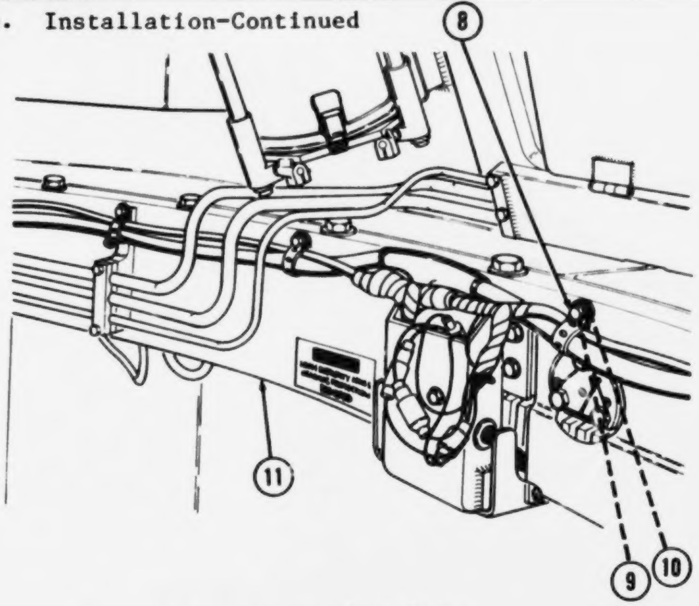
12 Install left rear shield (19) using seven flat washers (18), seven new lock washers (17) and seven screws (16).

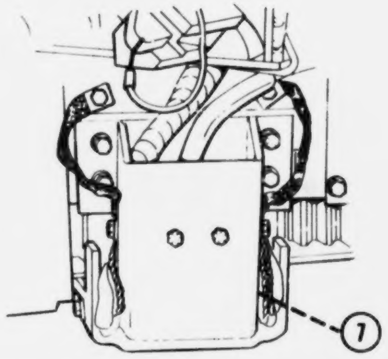
13 Install right rear shield (15) using seven flat washers (14), seven new lock washers (13) and seven screws (12).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-1. CAB — Continued

b. Installation-Continued





14 Install right front shield (11) using three flat washers (10), three new lock washers (9) and three screws (8).

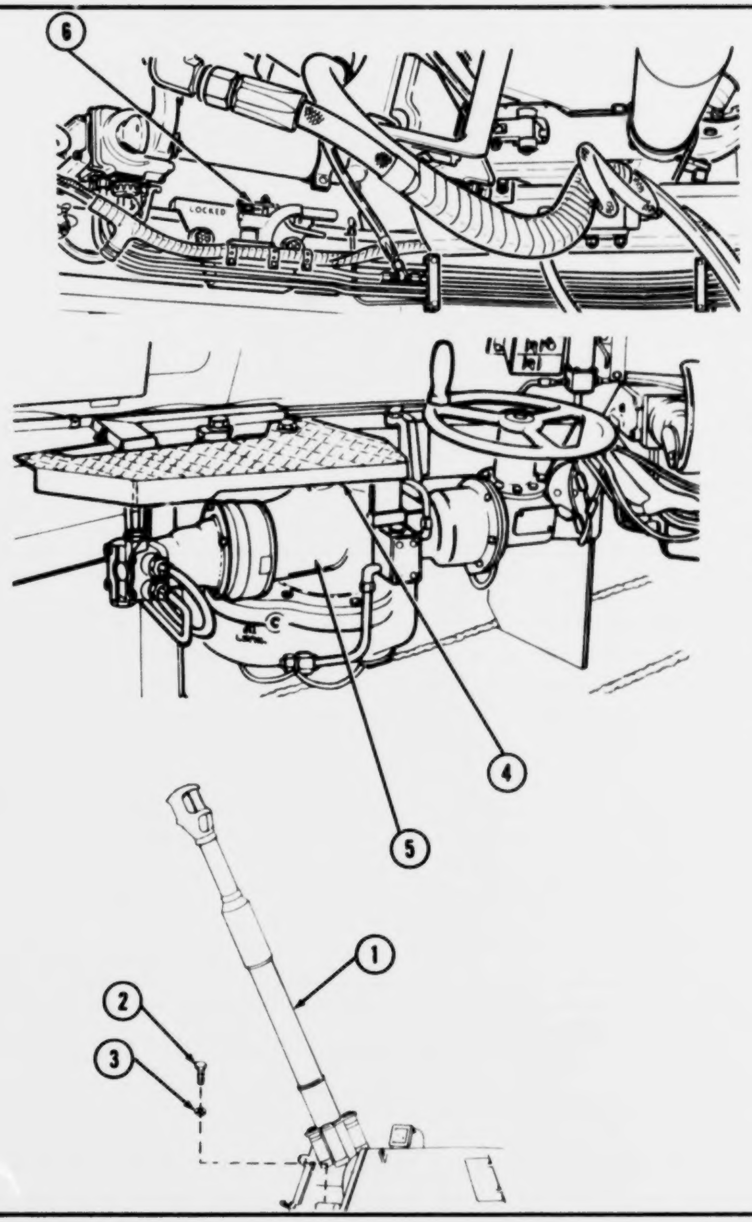
NOTE

Some vehicles have three electrical contact arm assemblies and some vehicles have five electrical contact arm assemblies.

15 Check battery ground cable and make sure it is still disconnected. Check MASTER and CAB POWER switches and make sure they are still OFF.

16 Untape or unwire electrical contact arm assemblies (7) from top of cab ring plate.

17 Install electrical contact arm assemblies (7) (ref. TM 9-2350-311-20-2).



18 Install turret lock (6) (ref. TM 9-2350-311-20-2).

19 Install traversing mechanism (5) (ref. page 9-66) and traversing mechanism step plate (4) (ref. page 9-27).

20 Connect battery ground cables (ref. TM 9-2350-311-20-1).

21 Fill and charge cab hydraulic system (ref. TM 9-2350-311-20-2).

22 Elevate cannon assembly (1) to maximum elevation. Install three flat washers (3) and three bolts (2) in bottom of trunnion support bracket outside cab. Torque to 320 lb-ft (434 N·m).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-2. BEARING ASSEMBLY RACE RING

This task covers:

a. Removal b. Disassembly c. Inspection and Repair

d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts	Special Tools	Personnel Required
Lock wire	Hoist, cab lifting (Item 2, App. B)	3
Grease (Item 9, App. C)	Sling, cab lifting (Item 5, App. B)	
Inflatable rubber seal 11605055 (some vehicles require)	Wooden blocks	
	Micrometer (outside)	
	Eye Bolt (3) (Item 13, App. B)	

a. Removal

WARNING

Personnel should wear steel-tipped safety shoes and safety glasses to avoid possible injury.

CAUTION

Electrical contact segment ring may be removed prior to removal of bearing assembly race ring to protect it from possible damage (ref. TM 9-2350-311-20-2). If removed, place electrical contact segment ring in a secure place.

NOTE

- Cab assembly must be removed prior to removal of bearing assembly race ring (ref. page 3-2).
- Bearing assembly components vary between earlier and later production vehicles.
- Vehicles with five electrical arm assemblies have bearing assemblies with these characteristics:

  Number of ball bearings is 212.

  212 ball bearings are separated by 106 metal spacer plates.
- Not all vehicles with three contact arm assemblies have same bearing assembly components. When maintenance inspections call for replacement of all bearings, the helical springs used on earlier production models are being replaced by metal spacer plates.
- Vehicles having three contact arm assemblies (which have not had springs replaced by spacers) have these characteristics:

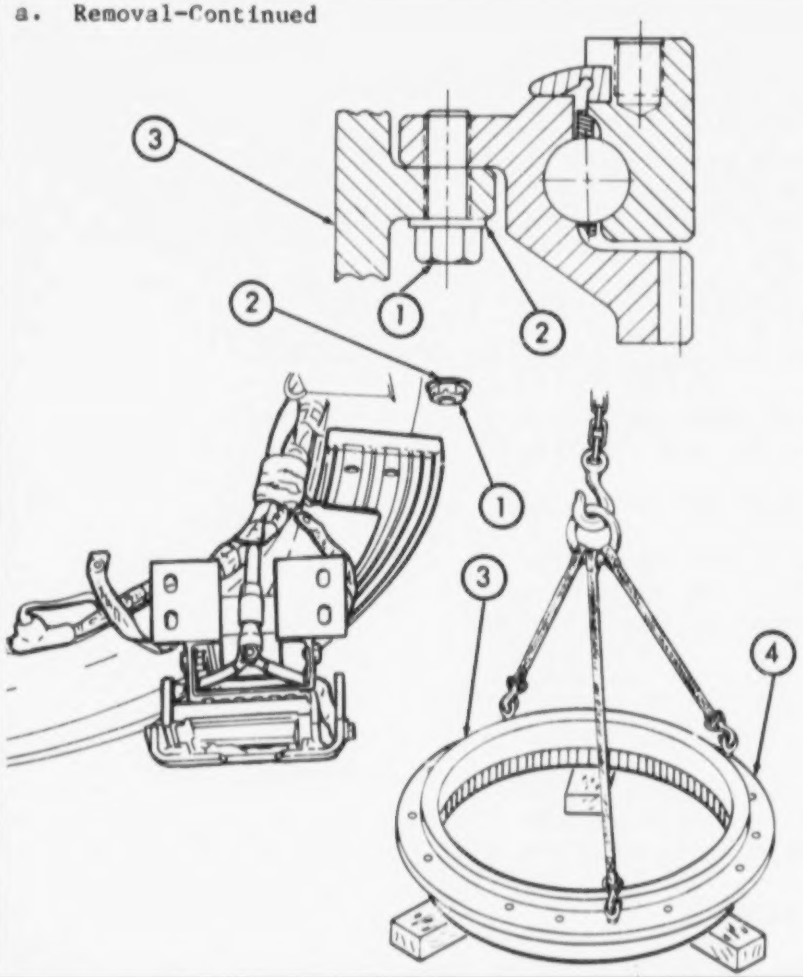
  Number of ball bearings is 213.

  213 ball bearings are separated by 213 helical springs.

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-2. BEARING ASSEMBLY RACE RING — Continued

a. Removal-Continued



1 Remove 48 bolts (1) and 48 flat washers (2) from bottom of race ring assembly (3).

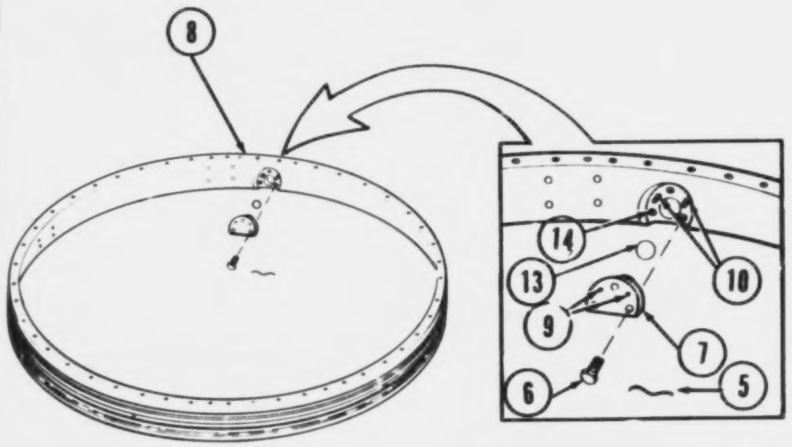
2 Install three eye bolts (Item 13, App. B) in outer race ring (4) bolt holes at 120° intervals (every 16th hole) as shown.

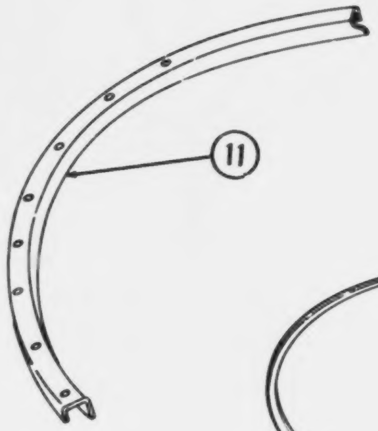
3 Attach sling(s) (Item 5, App. B) to three eyebolts (Item 13, App. B). Attach hoist (Item 2, App. B) to sling(s) (Item 5, App. B) as shown.

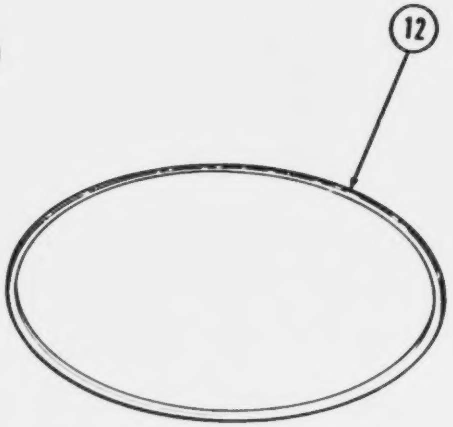
4 Lift race ring assembly (3) out of hull and position on wooden blocks as shown.

5 Detach hoist (Item 2, App. B) and sling(s) (Item 5, App. B). Remove three eyebolts (Item 13, App. B).

b. Disassembly







1 Remove lock wire (5), three screws (6) and access cover (7) from inner race ring (8). Discard lock wire (5).

2 Screw two bolts into access cover guide holes (9) to remove access cover (7) from two pins (10) on inner race ring (8).

NOTE

Some race ring assemblies have an inflatable seal held in place by a seal retainer.

3 Remove seal retainer (11) if necessary.

4 Remove seal (12) from inner race ring (8).

NOTE

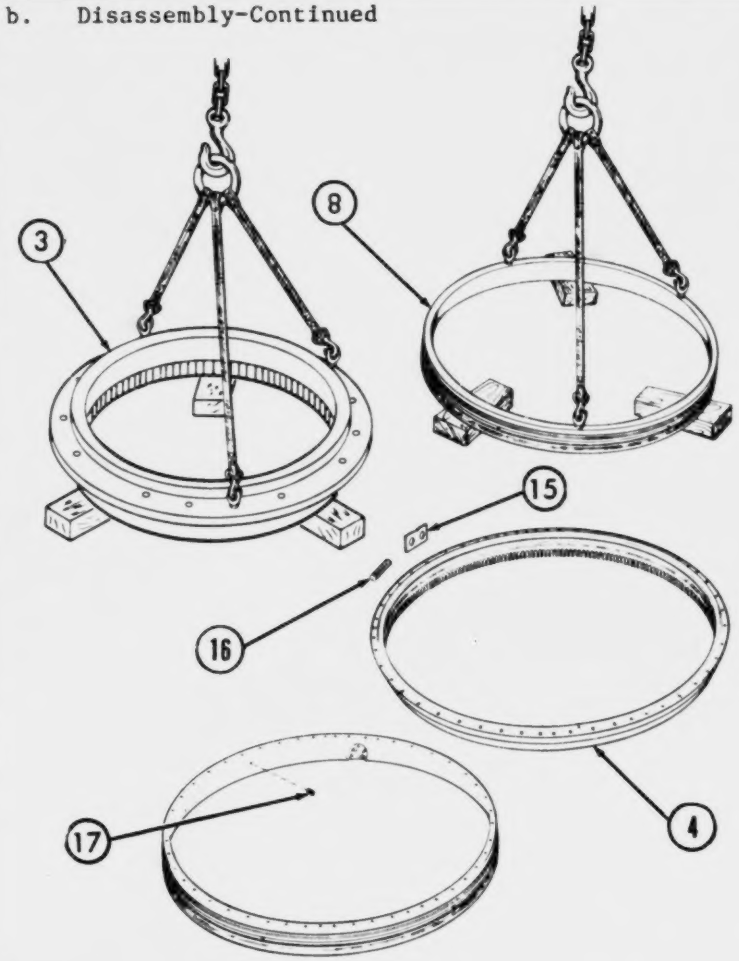
If balls do not roll out of access hole easily, use long thin tweezers to pull balls from access hole.

5 Rotate inner race ring (8) to remove 212 or 213 ball bearings (13) from access hole (14).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-2. BEARING ASSEMBLY RACE RING – Continued

b. Disassembly-Continued



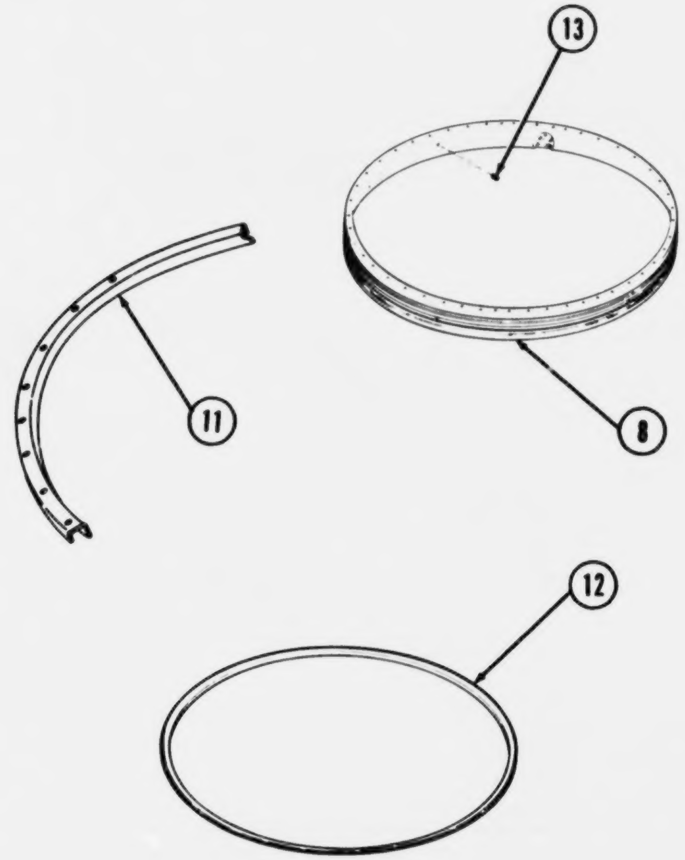
6 Attach three eyebolts (Item 13, App. B) to inner race ring (8) at approximate 120° intervals (every 9th hole) as shown.

7 Attach sling(s) (Item 5, App.B) to three eyebolts (Item 13, App. B). Attach hoist (Item 2, App. B) to sling(s) (Item 5, App. B) as shown. Lift inner race ring (8) out of race ring assembly (3). Position inner race ring (8) on wooden blocks.

8 Remove 106 spacers (15) or 213 springs (16) from outer race ring (4).

9 Remove three plugs (17) from inner race ring (8).

c. Inspection and Repair



NOTE

Cleaning and inspection of springs is not necessary as springs will be completely replaced by spacers during assembly.

1 Inspect race rings (8) and (4). Retap if threads are damaged. Remove minor nicks from race to teeth with a fine stone. Replace entire race ring assembly (3) if inner race ring (8) or outer race ring (4) is cracked, broken, distorted or teeth are badly marred, chipped or broken.

2 Inspect seal retainer (11) and seal (12) Replace if cracked, worn or damaged.

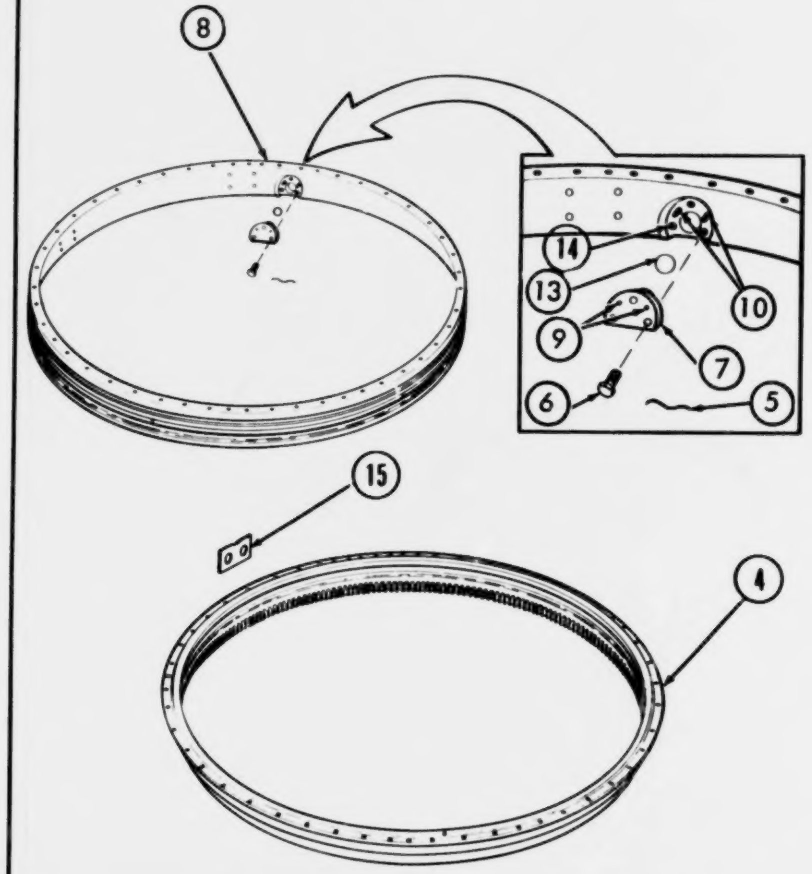
3 Inspect and measure ball bearings (13). Replace if pitted, out-of-round or if diameter is less than 1.249 inch (31.7mm).

4 Inspect spacers (15). Replace if damaged.

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-2. BEARING ASSEMBLY RACE RING – Continued

d. Assembly



NOTE

Any race ring assembly having 213 springs must have springs replaced with 106 spacers.

1 Apply grease (Item 9, App. C) to 106 spacers (15). Position 106 spacers (15) around outer race ring (4).

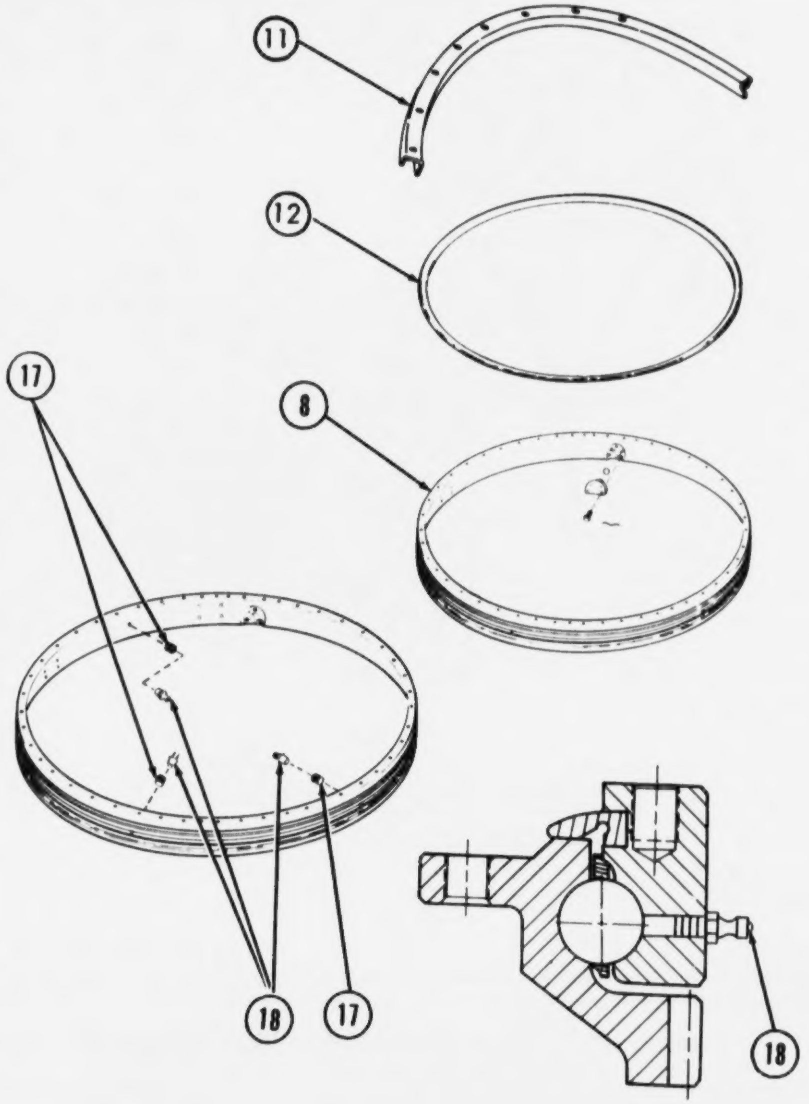
2 Position inner race ring (8) in outer race ring (4).

NOTE

Relieve binding of inner race ring during installation of ball bearings by using small pry bar.

3 Rotate inner race ring (8) and install 212 ball bearings (13) into 106 spacers (15) through access hole (14). Use long, thin tweezers to position 106 spacers (15) for insertion of 212 ball bearings (13).

4 Install access cover (7) on inner race ring (8) over two pins (10) using access cover guide holes (9). Install three screws (6) and new lock wire (5).



NOTE

Some race ring assemblies have an inflatable seal held in place by a seal retainer.

5 Install new seal (12) on inner race ring (8), if seal (12) was removed during removal.

6 Install seal retainer (11) if removed during removal.

7 Install three lubrication fittings (18) in holes for three plugs (17).

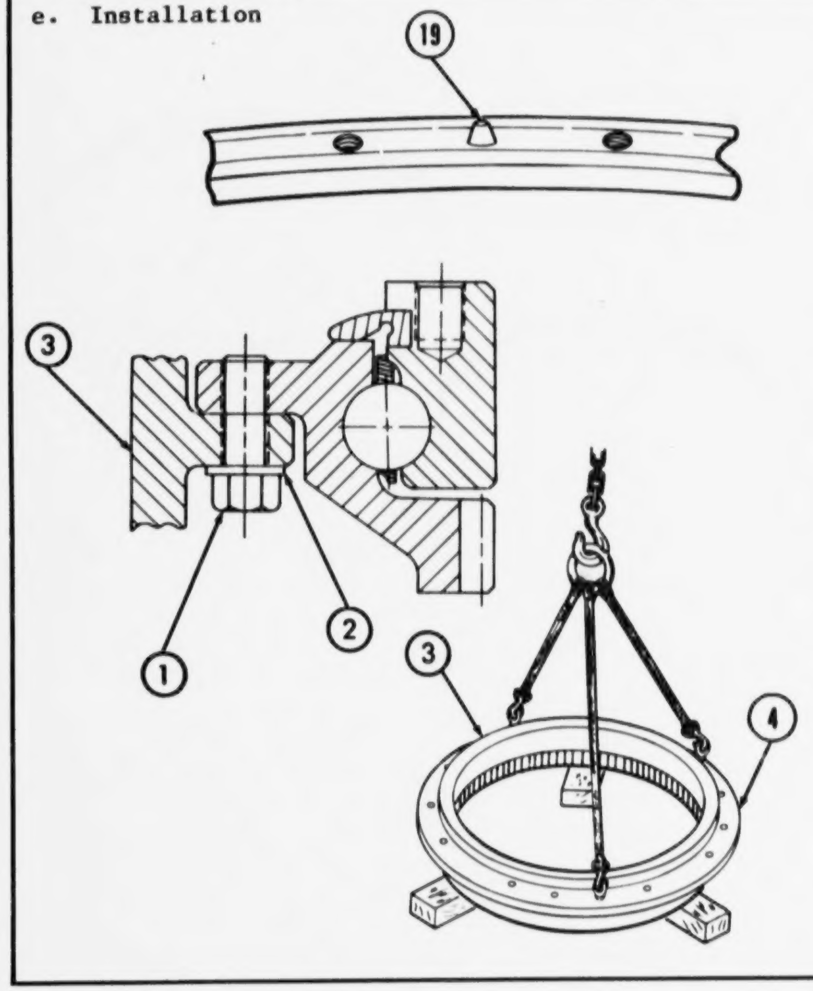
8 Rotate inner race ring (8) slowly, applying grease (Item 9, App. C) at lubrication fittings (18). Apply 1/2 to 3/4 pound of grease (Item 9, App. C).

9 Remove three lubrication fittings (18). Install three plugs (17) in inner race ring (8).

CAB AND BEARING ASSEMBLY RACE RING — Continued

3-2. BEARING ASSEMBLY RACE RING — Continued

e. Installation



1 Install three eyebolts (Item 13 App. B) in outer race ring (4) bolt holes at 120° intervals (every 16th hole) as shown:

2 Attach sling(s) (Item 5, App. B) to three eyebolts (Item 13, App. B). Attach hoist (Item 2, App. B) to sling(s) (Item 5, App. B) as shown.

3 Lift race ring assembly (3) and position over hull. Aline unthreaded race ring assembly (3) alinement holes with hull mounted alinement pins (19).

4 Aline bolt holes in outer race ring (4) with mating holes in hull mounting surface. Lower race ring assembly (3) into hull.

5 Detach hoist (Item 2, App. B) and sling(s) (Item 5, App. B). Remove three eyebolts (Item 13, App. B).

6 Install four flat washers (2) and four bolts (1) in bottom of race ring assembly (3) at 90° intervals (every 12th bolt hole) to insure alinement of ring to hull.

7 Install 44 flat washers (2) and 44 bolts (1). Torque 48 bolts (1) to 272 lb-ft (368 N·m).

NOTE

- For installation of electrical contact segment ring, ref. TM 9-2350-311-20-2.
- For installation of cab assembly, ref. page 3-8.

CHAPTER 4 MOUNT AND HOWITZER ASSEMBLY

GENERAL

This chapter illustrates and provides maintenance procedures for the mount and howitzer assembly. These procedures are functions authorized for direct and general support level maintenance. The paragraphs deal, as applicable, with removal, disassembly, cleaning, inspection, repair, assembly, testing, adjustment and installation.

Title — Page

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET 4-2

4-2. CANNON ASSEMBLY 4-32

4-3. MUZZLE BRAKE AND THRUST COLLAR 4-72

4-4. BORE EVACUATOR 4-76

4-5. CANNON TUBE 4-79

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4-7. BREECH MECHANISM 4-96

4-8. BREECHBLOCK ASSEMBLY 4-120

4-9. OPERATING CRANK ASSEMBLY 4-122

4-10. CARRIER ASSEMBLY 4-124

4-11. HANDLE ASSEMBLY 4-132

4-12. DAMPER ASSEMBLY 4-135

4-13. BREECH CAM AND PIN ASSEMBLY 4-136

4-14. RECUPERATOR ASSEMBLY 4-146

4-15. VARIABLE RECOIL ASSEMBLY 4-210

4-16. BUFFER ASSEMBLY 4-221

4-17. ACTUATOR AND FOLLOWER ASSEMBLY 4-236

4-18. ACCUMULATOR REPLENISHER ASSEMBLY 4-242

MOUNT AND HOWITZER ASSEMBLY

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET

This task covers: a. Removal b. Installation

INITIAL SET-UP

Materials/Parts
- Lock washers
- Lock wire
- Self locking nuts

Special Tools
- Wooden blocks or fabricated cannon tripods (App. E)
- Cab lifting sling (Item 5, App. B)
- Gun tube sling (Item 6, App. B)
- Elevation cylinder supporting strap
- Test gage (P/N 8213259)

Personnel Required
4

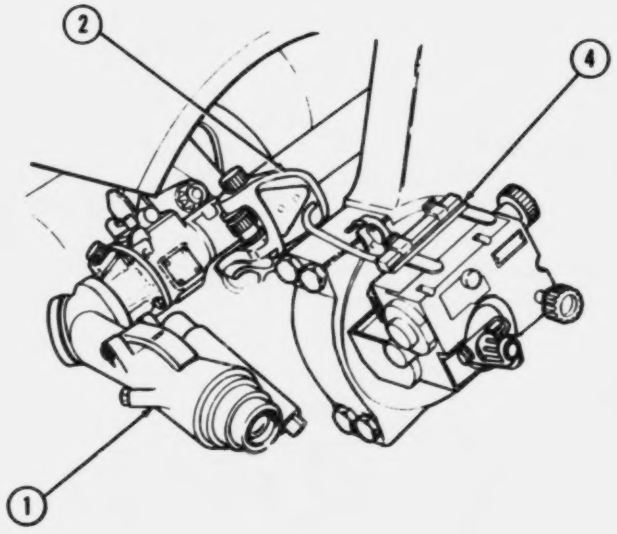
a. Removal

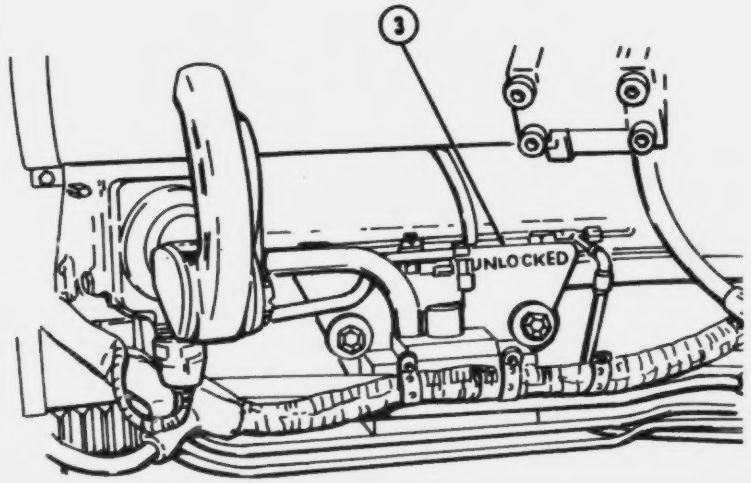
WARNING

- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.
- Vehicle must be on level terrain with vehicle brake lock handle applied to avoid possible injury due to vehicular movement.
- Make sure CAB POWER and MASTER switches are OFF. Disconnect battery ground cable at battery terminal (ref. TM 9-2350-311-20-2). Failure to follow this procedure could result in serious burns or electrical shock.

CAUTION

To avoid damage to equipment, a number of fire control and hydraulic assemblies must be removed prior to removal of mount and howitzer with trunnion bracket. Procedures for removing this equipment are detailed below.





1 Remove elbow telescope M118A2 (1) and mount M146 (2) (ref. TM 9-2350-311-20-2).

2 Center cannon and elevate approximately 300 mils.

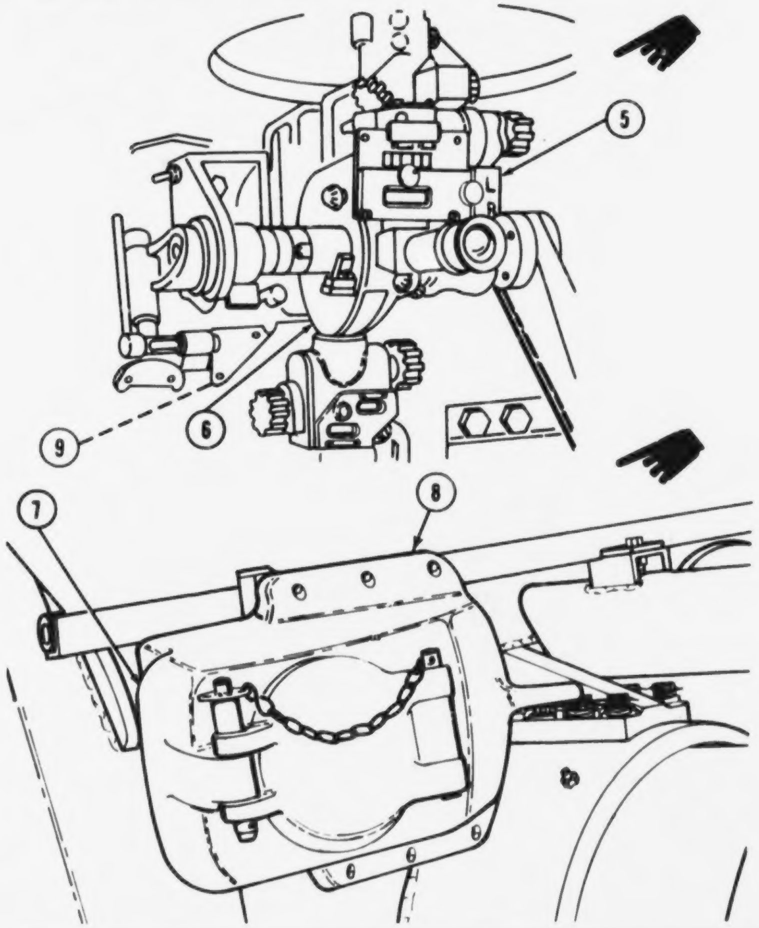
3 Place turret lock (3) in LOCKED position.

4 Remove elevation quadrant M15 (4) (ref. TM 9-2350-311-20-2).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

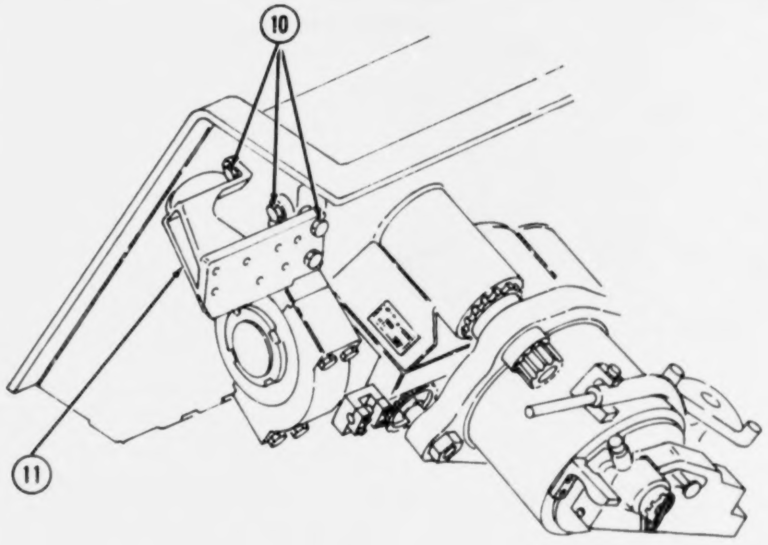
a. Removal-Continued

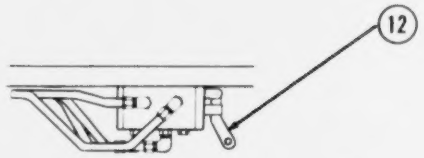


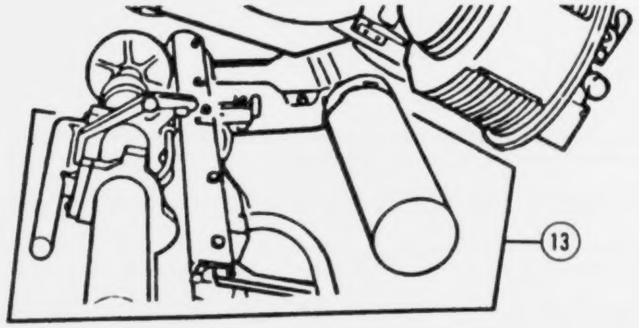
5 Remove panoramic telescope M117A2 (5) and mount M145 (6) (ref. TM 9-2350-311-20-2).

6 Remove offset periscope M42 (7) and cover (8) (ref. TM 9-2350-311-20-2).

7 Remove collimator control bracket (9) (ref. TM 9-2350-311-20-2).







NOTE

To prevent misalinement of telescope, do not remove alinement plate from panoramic telescope support assembly.

8 Remove six screws (10) and panoramic telescope support assembly (11).

NOTE

Remove only those hydraulic hoses and tubes required to remove mount and howitzer assembly.

9 Drain hydraulic system and disconnect hydraulic hose and tubes (ref. TM 9-2350-311-20-2).

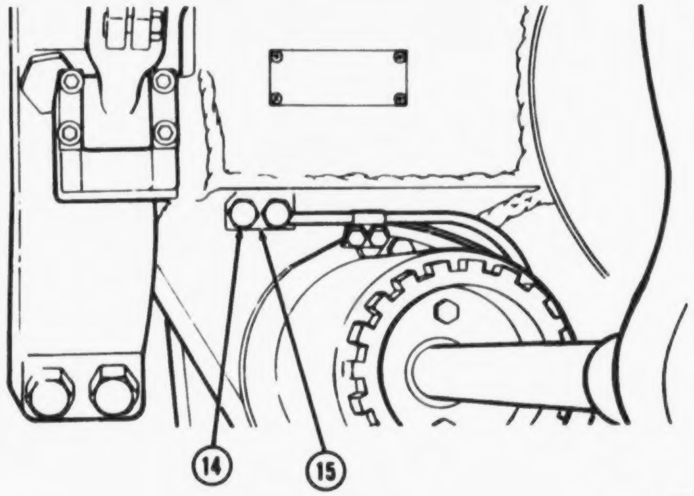
10 Remove rammer actuating valve (12) (ref. TM 9-2350-311-20-2).

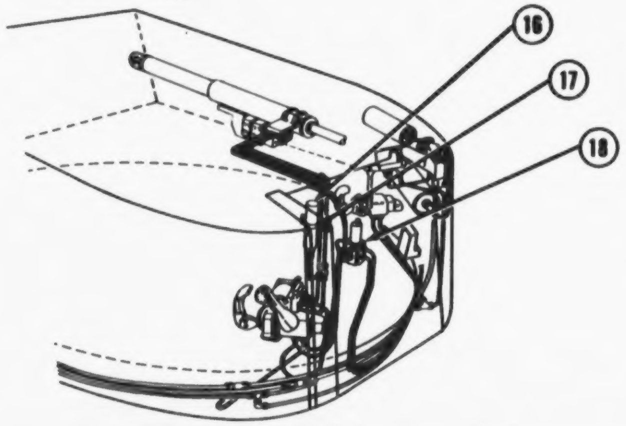
11 Remove rammer assembly (13) (ref. page 6-4).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

a. Removal-Continued





12 Relieve hydraulic pressure of replenisher accumulator by opening left-hand bleeder plug (14) on manifold (15). Catch fluid in suitable container.

NOTE

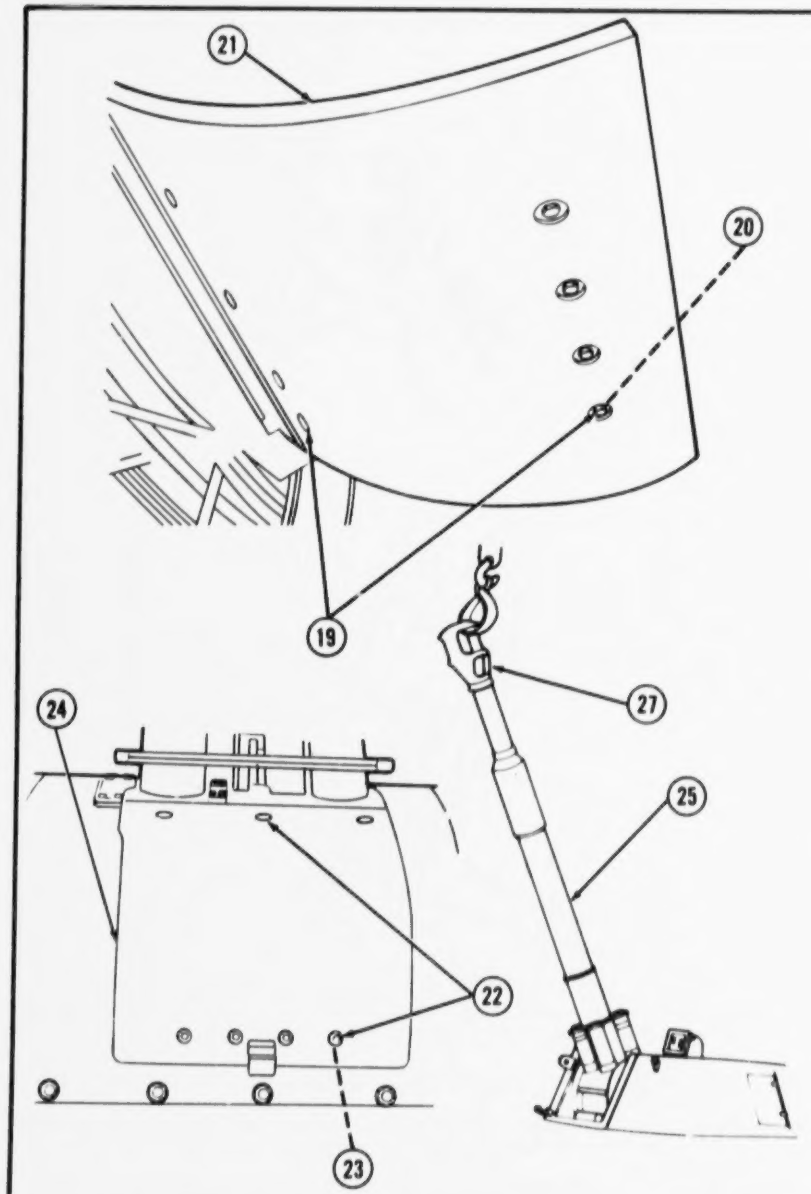
Draining system in step 13 will drain only buffer and accumulator replenisher.

13 Drain hydraulic system by disconnecting hydraulic tube at buffer. Catch fluid in suitable container (ref. TM 9-2350-311-20-2).

14 Disconnect hose at replenisher manifold at top of mount (ref. TM 9-2350-311-20-2).

15 Remove manual elevation accumulator (16) and clamp (17) from trunnion support bracket (ref. TM 9-2350-311-20-2).

16 Remove elevation selector valve (18) from trunnion support bracket (ref. TM 9-2350-311-20-2).



WARNING

Support lower rotor during removal. Lower rotor weighs approximately 57 pounds (26 kilograms) and may cause injury if dropped.

17 Remove eight socket head cap screws (19), eight lock washers (20), and lower gun shield (21). Discard eight lock washers (20).

18 Remove weather cover (ref. page 8-2).

19 Remove seven socket head cap screws (22) and seven lock washers (23) on upper rotor (24). Upper rotor (24) will remain in place until cannon (25) is elevated. Discard seven lock washers (23).

20 Before raising cannon tube (25), open front and rear bleed valves on the elevating cylinder (ref. page 5-113). This will prevent cylinder piston rod (26) from being bent.

21 Attach gun tube sling (Item 6, App. B) and hoist to muzzle brake (27).

WARNING

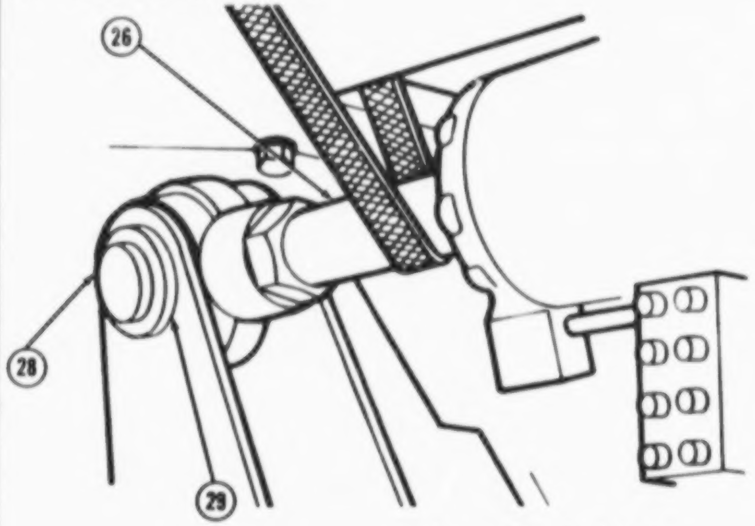
Two personnel are required for removal of upper rotor. Rotor weighs approximately 75 pounds (34 kilograms) and may cause injury if dropped.

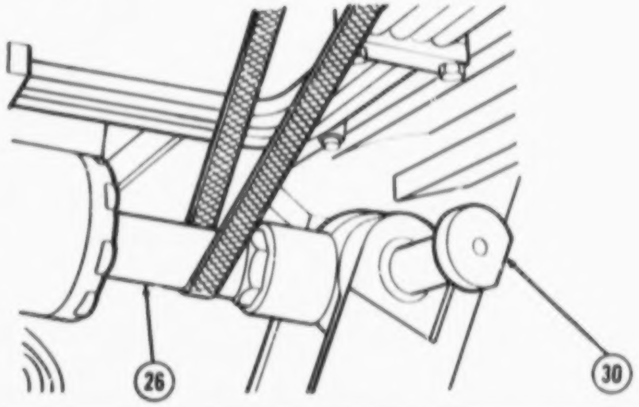
22 Raise cannon (25) to maximum elevation and remove upper rotor (24) from inside cab.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

a. **Removal-Continued**



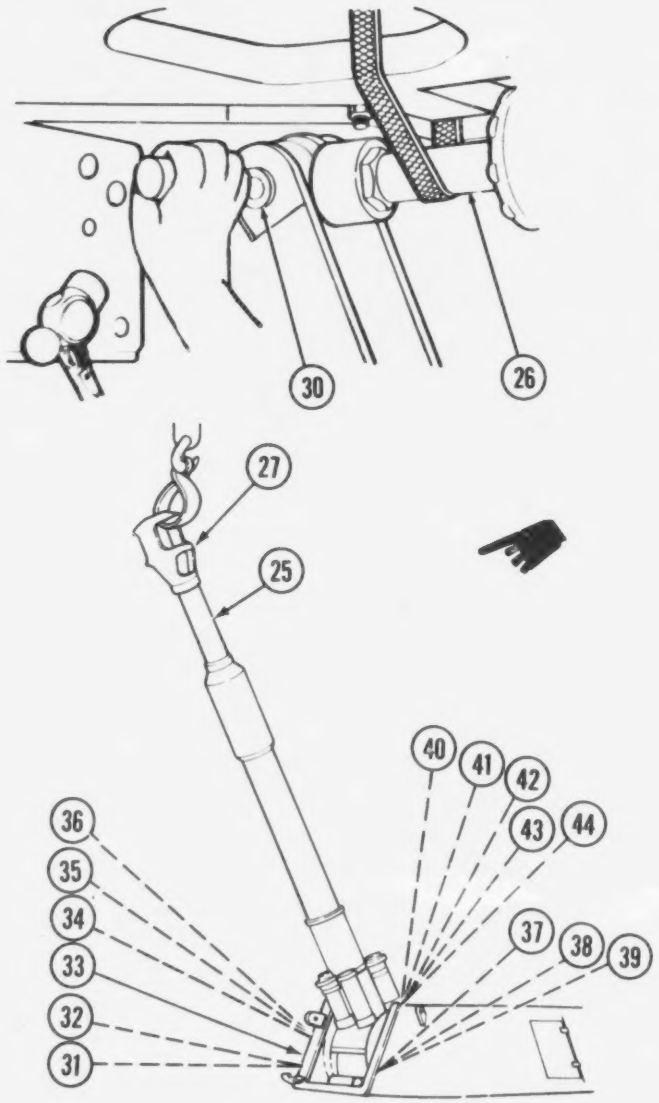


23 Remove panoramic telescope ballistic cover (ref. TM 9-2350-311-20-2).

24 Support elevating cylinder piston rod (26) with supporting strap through ballistic cover hole and around cylinder piston rod (26).

25 Remove nut (28) and lock washer (29) at forward end of cylinder piston rod (26). Discard lock washer (29).

26 Rotate pin (30) to a position where flat surface on head will clear recoil cylinder. Use brass drift and hammer to drive out pin (30).



27 With cannon (25) still at maximum elevation, remove three bolts (31) and three flat washers (32) from bottom of trunnion bracket assembly (33). Depress cannon (25) as required. It is permissible to depress cannon (25) as far as travel lock position.

28 Remove five hex head cap screws (34), five flat washers (35) and five self-locking nuts (36) from right side of trunnion bracket assembly (33). Discard five self-locking nuts (36).

29 Remove five hex head cap screws (37), five flat washers (38) and five self-locking nuts (39) from right side of trunnion bracket assembly (33). Discard five self-locking nuts (39).

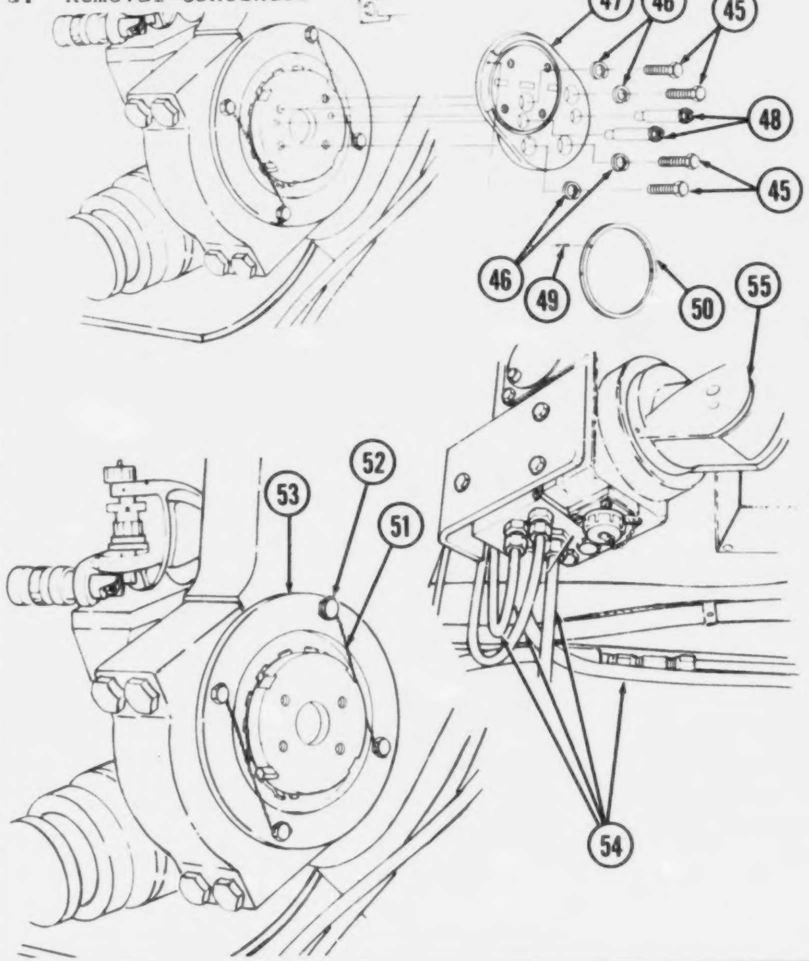
30 Remove ten screws (40), nine flat washers (41), ten self-locking nuts (42), shims (43) and spacer (44) from top of trunnion bracket assembly (33). Discard five self-locking nuts (42).

31 Remove gun tube sling (Item 6, App. B) and hoist from muzzle brake (27).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

a. Removal-Continued



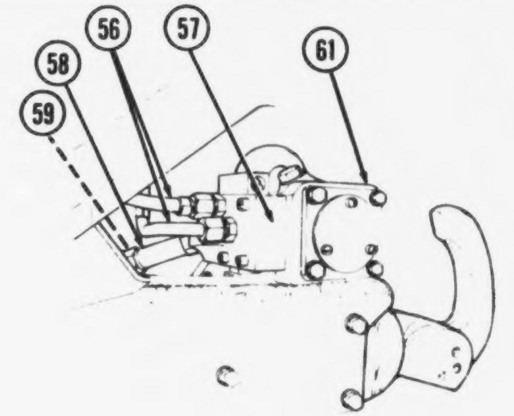
32 Remove four cap screws (45) and four lock washers (46) from trunnion support bracket (47). Discard four lock washers (46).

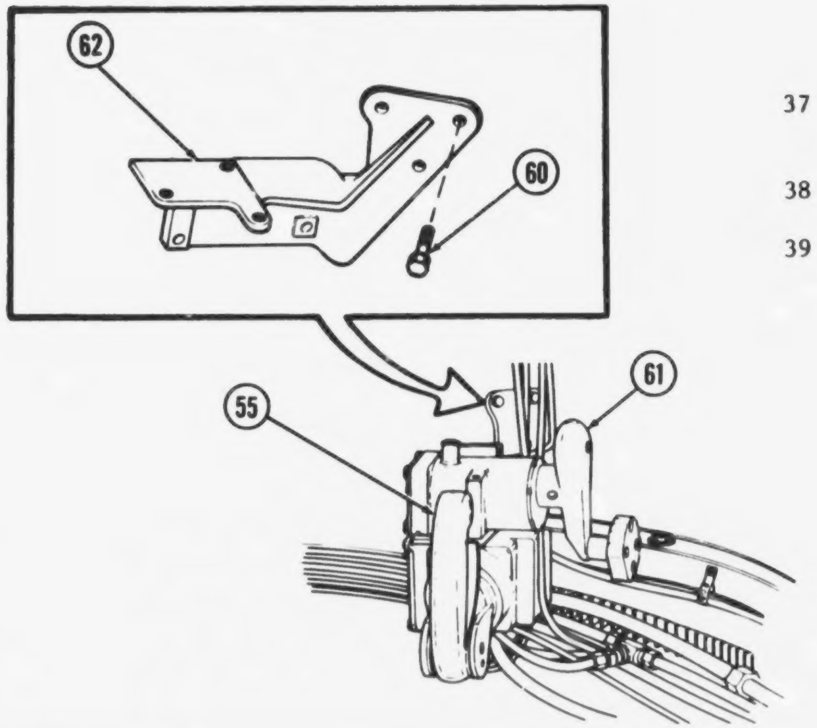
33 Loosen nuts on two expansion pin assemblies (48). Tap two expansion pin assemblies (48) in with brass hammer. Remove trunnion support bracket (47) with two expansion pin assemblies (48).

34 Remove two expansion pin assemblies (48), dowel pin (49) and taper ring (50) from trunnion support bracket (47).

35 Remove lock wire (51), four screws (52) and bearing retainer (53). Discard lock wire (51).

36 Disconnect four hydraulic tubes (54) at underside of assistant gunner's control (55).





37 Disconnect two tubes (56) at rear of manifold (57).

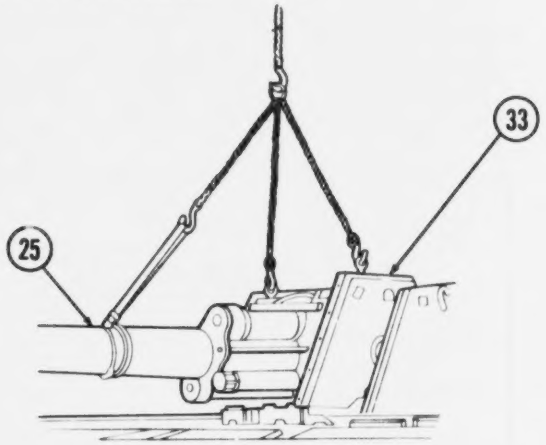
38 Disconnect one tube (58) at check valve (59).

39 Remove three machine bolts (60) and elevation control assembly (61). with assistant gunner's control (55) and elevation bracket (62).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

a. Removal-Continued

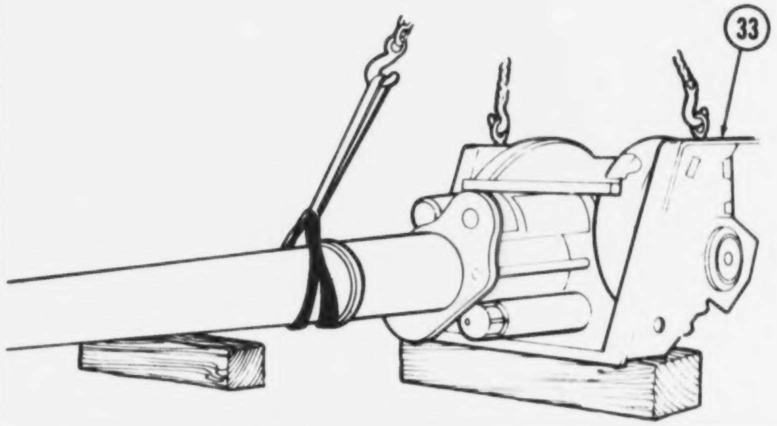


40 Depress cannon tube (25) to 0 mils elevation.

41 Attach lifting sling (Item 5, App. B) and gun tube sling to assembly as shown.

CAUTION

During removal of cannon, mount and trunnion bracket assembly, guide trunnion bracket carefully so that breech operating cam of cannon will not damage hydraulic lines at right inside of cab.



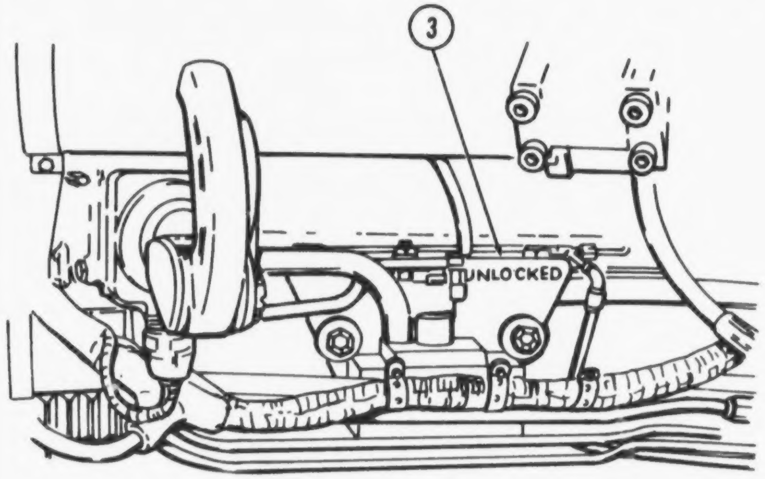
42 Connect lifting sling (Item 5, App. B) to lifting device.

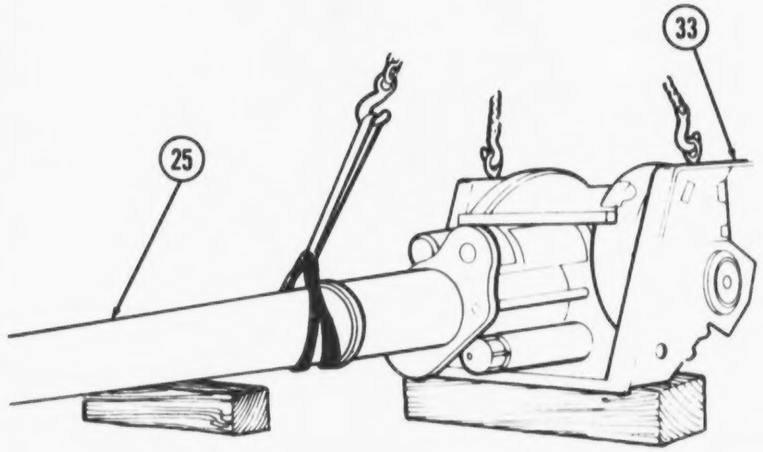
43 Raise slightly, then move horizontally to withdraw trunnion bracket assembly (33) from cab.

44 Place cannon tube (25) mount and trunnion bracket assembly (33) on blocks or fabricated cannon tripods (App. E).

45 Remove lifting sling and gun tube sling from trunnion bracket assembly (33).

b. Installation





WARNING

- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.
- Vehicle should be on level terrain with vehicle brake lock handle applied to avoid possible injury due to vehicular movement.
- Make sure CAB POWER and MASTER switches are OFF. Disconnect battery ground cable at battery terminal (ref. TM 9-2350-311-20-2). Failure to follow this procedure could result in serious burns and electrical shock.

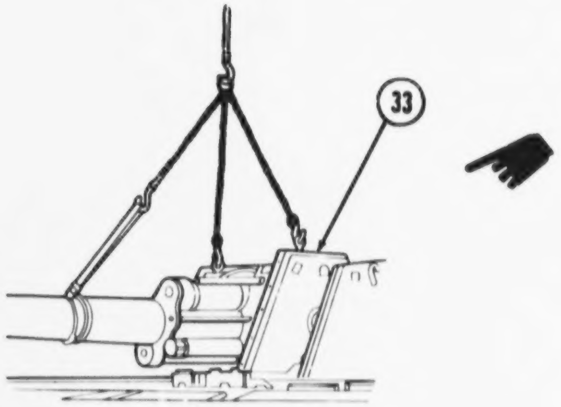
1 Place turret lock (3) in LOCKED position.

2 Attach lifting sling (Item 5, App. B) and gun tube sling to mount and howitzer with trunnion bracket assembly (33) as shown.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

b. Installation-Continued

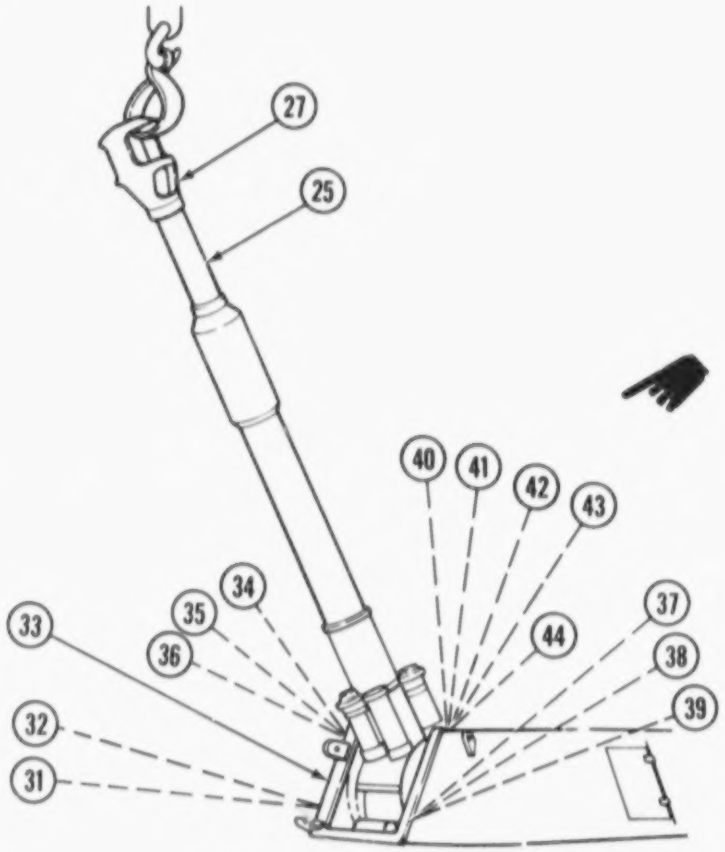


3 Connect lifting sling to lifting device.

CAUTION

During installation of cannon, mount and bracket, guide bracket carefully so that breech operating cam of cannon will not damage hydraulic lines at right side inside cab.

4 Raise assembly and move horizontally to install trunnion bracket assembly (33) in cab.



5 Install spacer (44) and shims (43) inside cab on top of trunnion bracket assembly (33) at center top screw hole.

6 Install nine flat washers (41), ten hex head cap screw (40) and ten new self-locking nuts (42) in top of trunnion bracket assembly (33). Screws are 2-3/4 inches (70 mm) long.

7 Install five flat washers (38), five hex head cap screws (34) and five new self-locking nuts (39) in right side of trunnion bracket assembly (33). Screws are 3-1/4 inches (83 mm) long.

8 Install five flat washers (35), five hex head cap screws (34) and five new self-locking nuts (36) in left side of trunnion bracket assembly (33). Screws are 4 inches (102 mm) long.

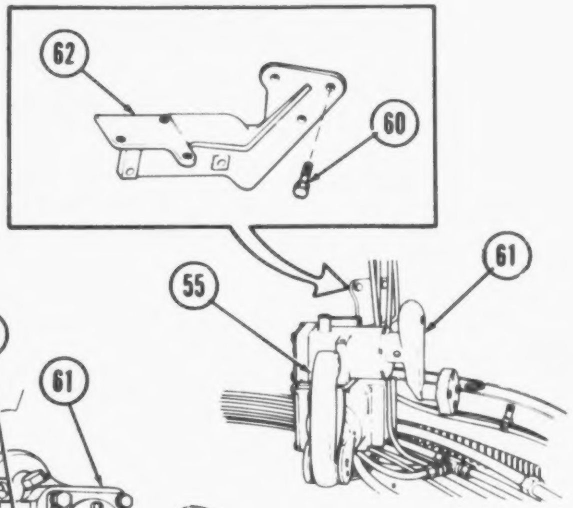
9 **Remove lifting sling and lifting device from trunnion bracket assembly (33) and attach gun tube sling and hoist to muzzle brake (27).**

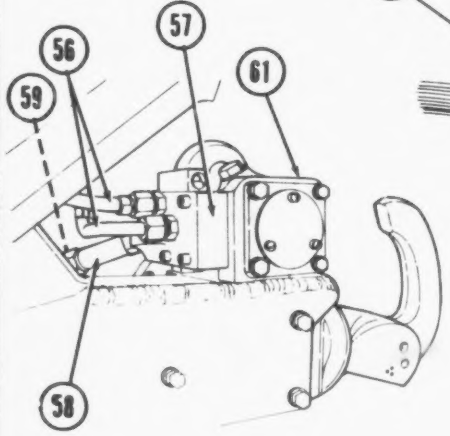
10 Elevate cannon tube (25) to maximum elevation and install three bolts (31) and three flat washers (32) in bottom of trunnion bracket assembly (33). Torque bolts to 270 lb-ft (366 kPa).

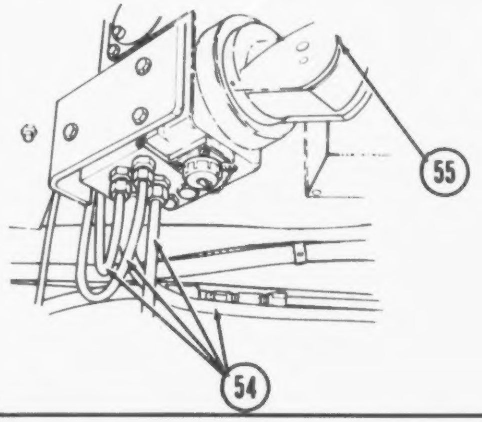
MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

b. Installation-Continued







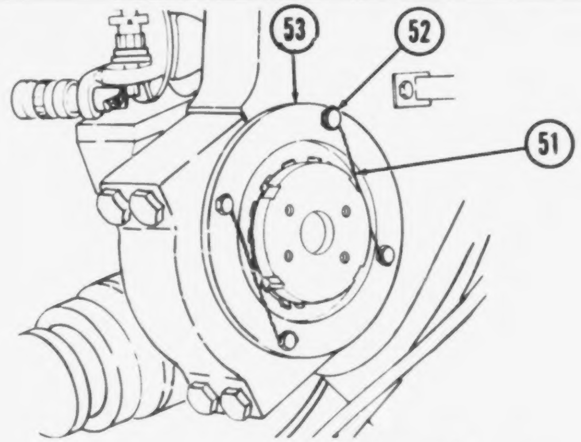
11 Install three machine bolts (60) and elevation control assembly (61) with assistant gunner's control (55) and elevation bracket (62).

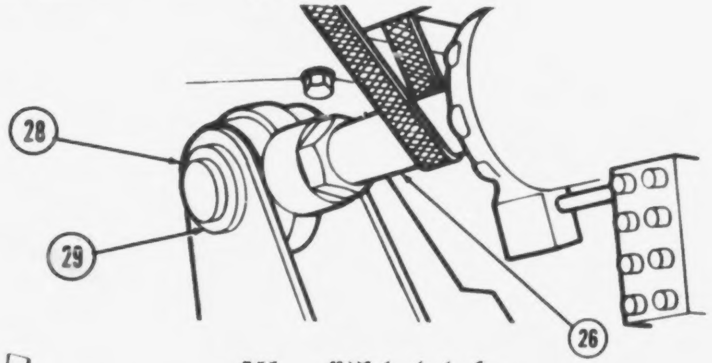
12 Connect tube (58) at check valve (59).

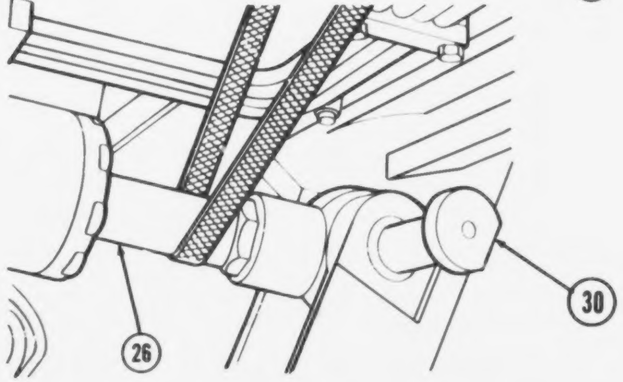
13 Connect two tubes (56) at rear of manifold (57).

14 Connect four hydraulic tubes (54) at underside of assistant gunner's control (55).

15 Install bearing retainer (53), four screws (52) and new lock wire (51).







16 Position pin (30) so that flat surface on head will clear recoil cylinder and insert pin (30) into forward end of cylinder piston rod (26).

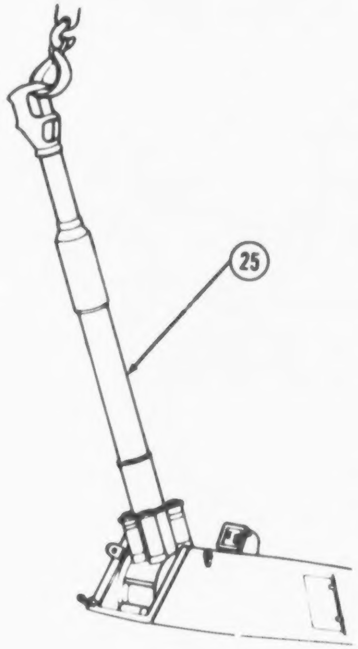
17 Install new lock washer (29) and nut (28) at forward end of cylinder piston rod (26).

18 Remove supporting strap from around piston rod (26).

19 Install panoramic telescope ballistic cover (ref. TM 9-2350-311-20-2).

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

b. Installation-Continued



WARNING

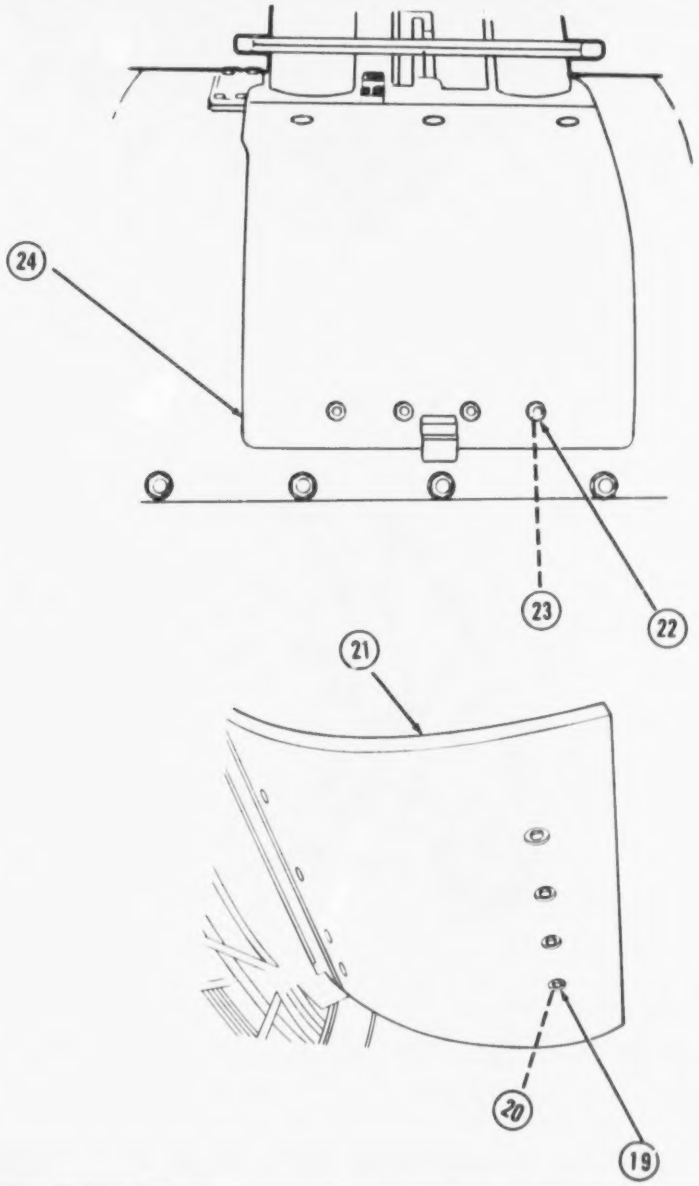
Two personnel are required for installation of upper rotor. Rotor weighs approximately 75 pounds (34 kilograms) and may cause injury if dropped.

20 With cannon (25) still at maximum elevation, install upper rotor (24) from inside of cab.

21 Depress cannon (25) to approximately 300 mils.

22 Install seven new lock washers (23) and seven socket head cap screws (22) on upper rotor (24).

23 Install upper rotor weather cover (ref. page 8-2).



WARNING

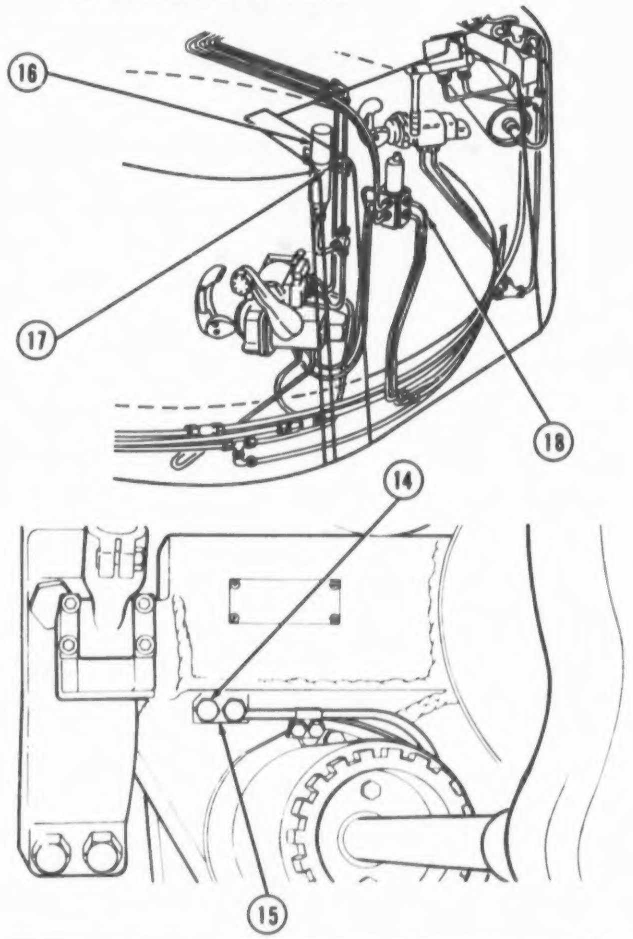
Support lower rotor during installation. Lower rotor weighs approximately 57 pounds (26 kilograms) and may cause injury if dropped.

24 Install lower gun shield (21), eight new lock washers (20) and eight socket head cap screws (19).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

b. Installation-Continued

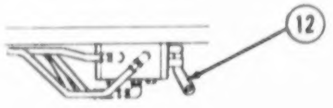


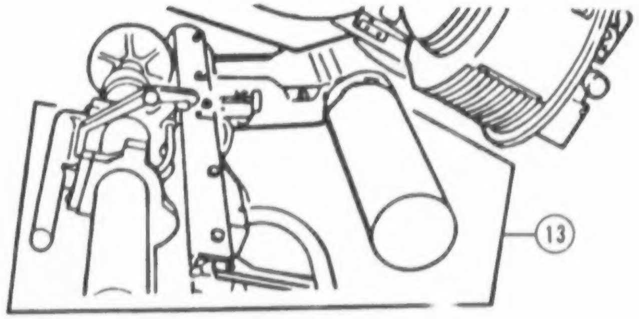
25 Install elvation selector valve (18) on trunnion bracket assembly (33) (ref. TM 9-2350-311-20-2).

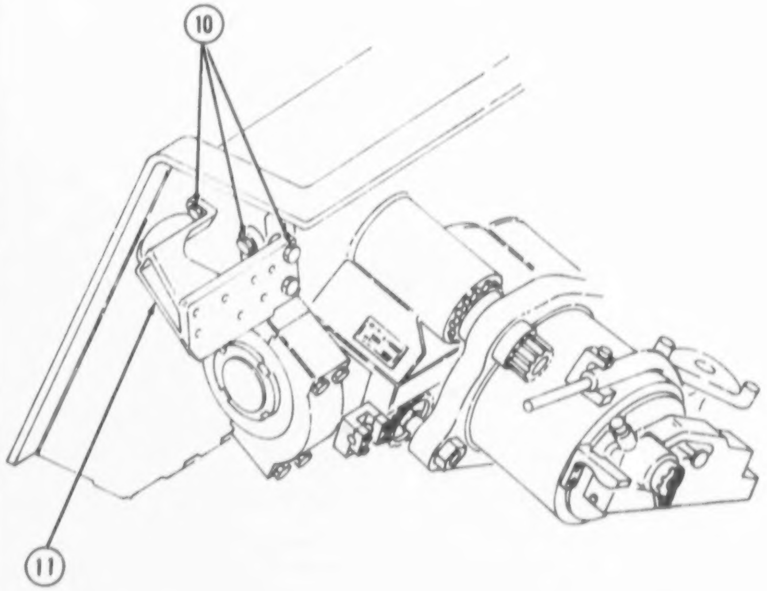
26 Install manual elevation accumulator (16) and clamp (17) on trunnion bracket assembly (33) (ref. TM 9-2350-311-20-2).

27 Connect hose at replenisher manifold at top of mount (ref. TM 9-2350-311-20-2).

28 Close left-hand bleeder plug (14) on manifold (15).







29 Install rammer assembly (13) (ref. page 6-4).

30 Install rammer actuating valve (12) (ref. TM 9-2350-311-20-2).

31 Connect hydraulic hoses and tubes and charge hydraulic system (ref. TM 9-2350-311-20-2).

32 Charge replenisher system with hydraulic fluid (ref. TM 9-2350-311-10).

33 Bleed air from cab hydraulic system (ref. TM 9-2350-311-20-2) and replenisher system (ref. TM 9-2350-311-10).

34 Install panoramic telescope support assembly (11) and six screws (10).

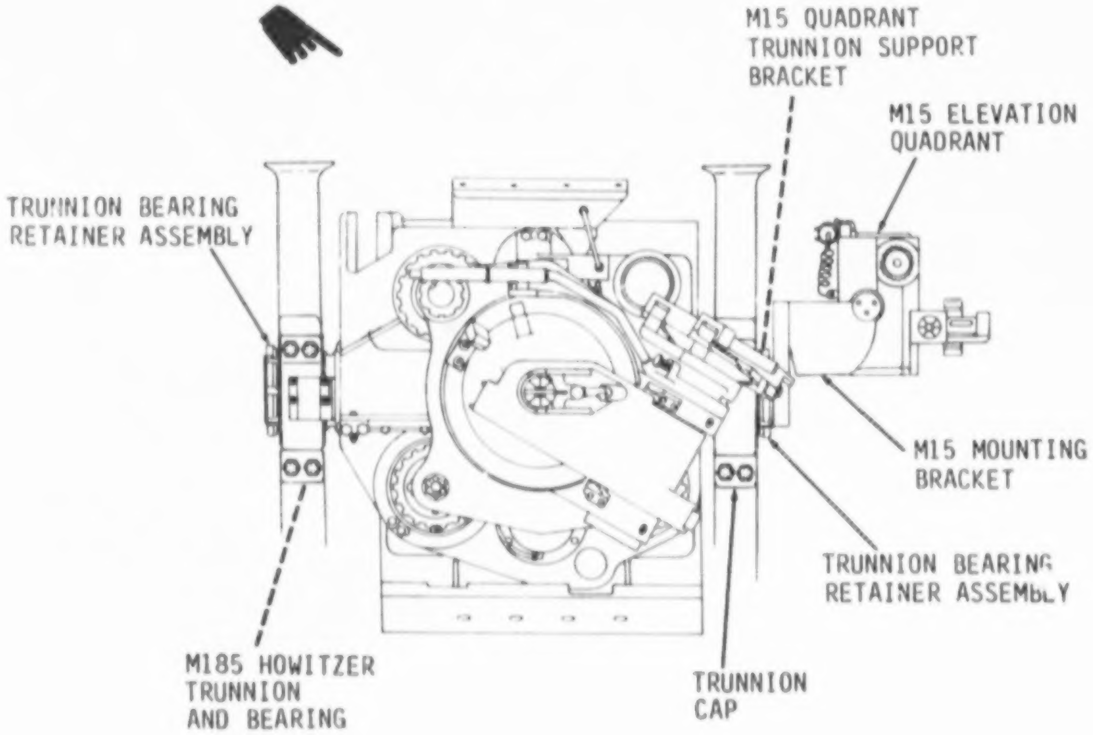
NOTE

When installing M145 mount on telescope support assembly, the M145 mount must be checked for alinement. Refer to TM 9-2350-311-20-2.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

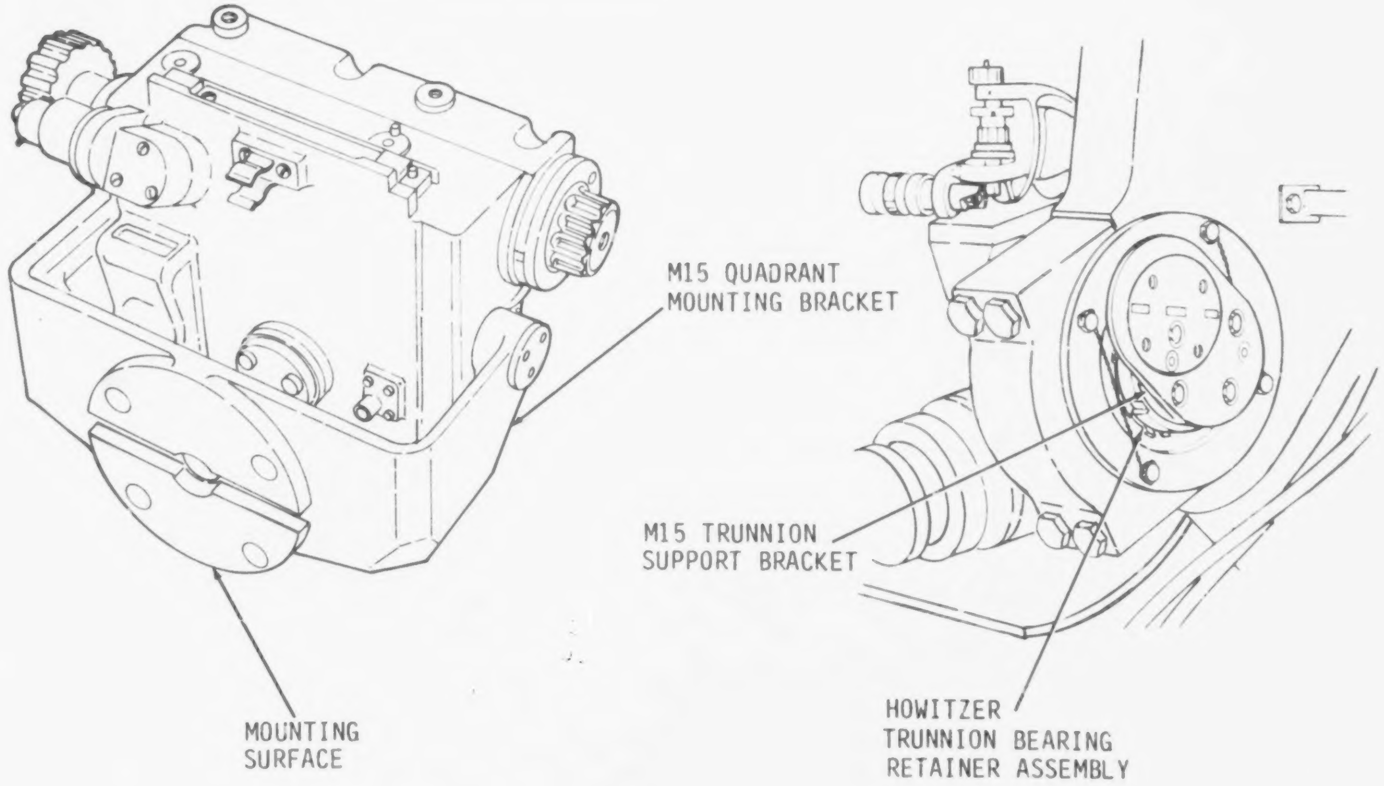
b. Installation-Continued


M15 QUADRANT TRUNNION SUPPORT BRACKET
M15 ELEVATION QUADRANT
TRUNNION BEARING RETAINER ASSEMBLY
M15 MOUNTING BRACKET
TRUNNION BEARING RETAINER ASSEMBLY
M185 HOWITZER TRUNNION AND BEARING
TRUNNION CAP

CAB INTERNAL LOCATOR FOR ALINING M15 ELEVATION QUADRANT TRUNNION MOUNTING BRACKET

NOTE

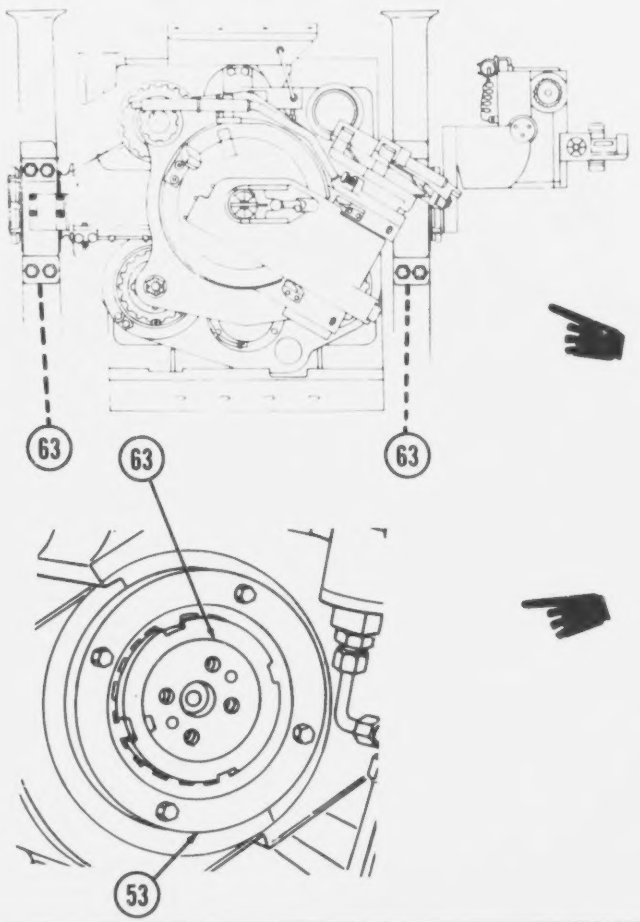
Steps 35-56 detail procedures for alining the M15 elevation quadrant trunnion bracket.


M15 QUADRANT
MOUNTING BRACKET
M15 TRUNNION
SUPPORT BRACKET
MOUNTING
SURFACE
HOWITZER
TRUNNION BEARING
RETAINER ASSEMBLY

MOUNT AND HOWITZER ASSEMBLY — Continued

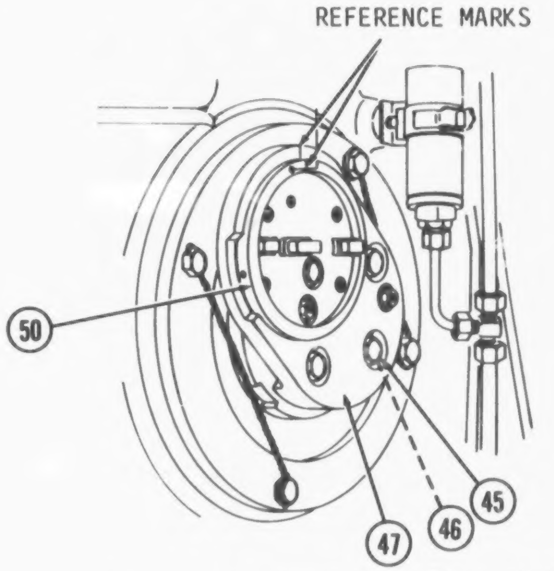
4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

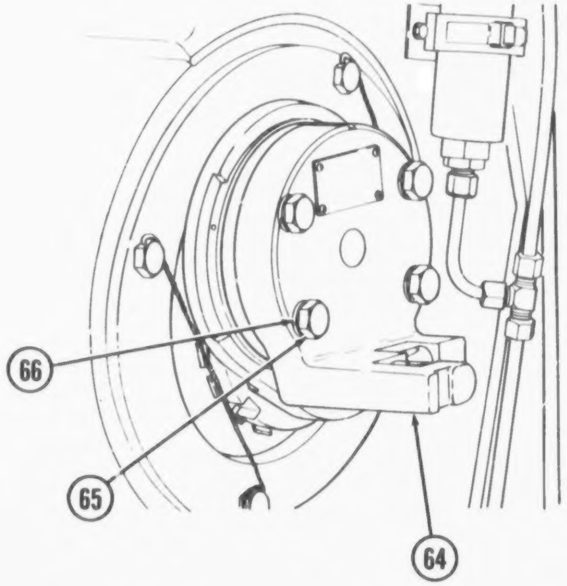
b. Installation-Continued



35 Level cannon trunnions (63) (ref. TM 9-2350-311-10).

36 Make certain that all mating surfaces of M15 elevation quadrant trunnion support bracket (47), cannon trunnion (63) and bearing retainer (53) are free of dirt, grease and burrs.





37 Install M15 elevation quadrant trunnion support bracket (47), four new lock washers (46) and four cap screws (45). Hand tighten four cap screws (45) only; do not tighten to final torque.

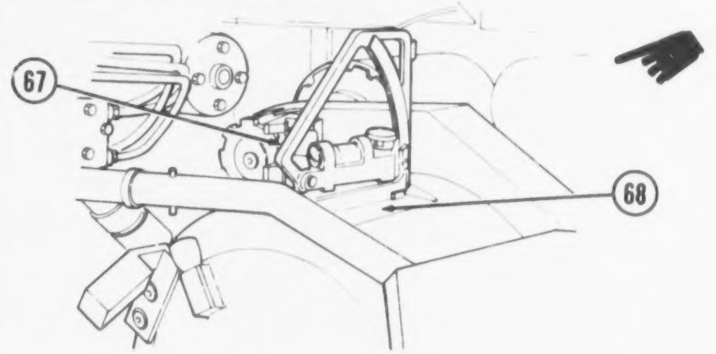
38 Install compensating taper ring (50) on trunnion support bracket (47), alining reference marks on compensating taper ring (50) with reference marks on trunnion support bracket (47).

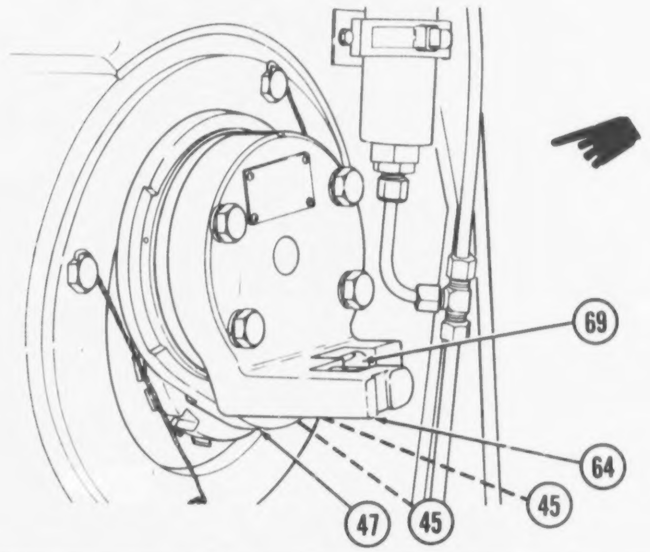
39 Install test gage (64) on trunnion support bracket (47) using the four 1/2-20 X 1-3/4 hex head cap screws (65) and washers (66) supplied with gage. Torque four hex head cap screws (65) to 20 lb-ft (27 N·m).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

b. Installation-Continued





WARNING

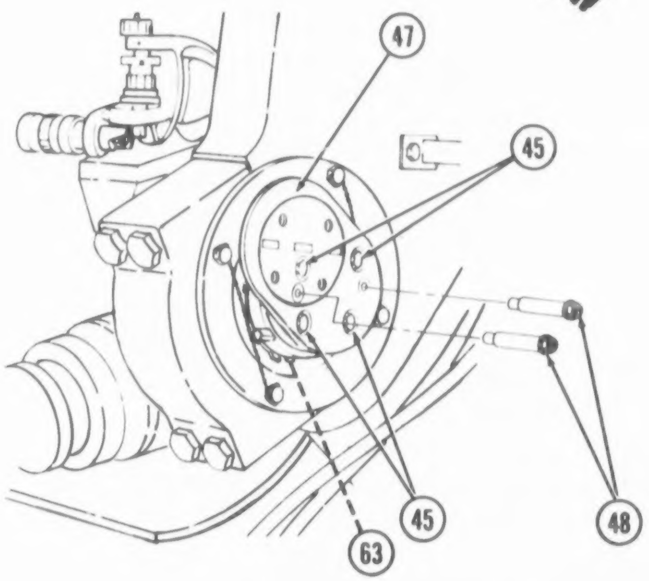
RADIATION HAZARD

TRITIUM GAS (H3)

M1A1/M1A2 gunner's quadrant is radioactively illuminated. Refer to page b for safety warnings and procedures.

40 Place an M1A1/M1A2 gunner's quadrant (67) on breech ring quadrant seat (68). The gunner's quadrant (67) should read 0 elevation ± 0.5 mil. If quadrant does not indicate this value, elevate and depress cannon until quadrant (67) does indicate 0 elevation ± 0.5 mil.

41 Move M15 elevation quadrant trunnion support bracket (47) as required until bubble in elevation level vial (69) of test gage (64) is centered. Only a slight amount of movement of bracket (47) should be required. When bubble in test gage elevation level vial (69) is centered, torque two accessible cap screws (45) which secure trunnion support bracket (47) to cannon trunnion (63) to 30 lb-ft (41 N·m).



42 Remove test gage (64) from trunnion support bracket (47). Tighten remaining two cap screws (45) to 30 lb-ft (41 N·m).

43 Repeat steps 36 and 37 to make sure that test gage (64) level bubble is same as M1A1 gunner's quadrant (67). If level bubbles are not the same, repeat steps 38 and 39. Remove test gage (64) from trunnion support bracket (47).

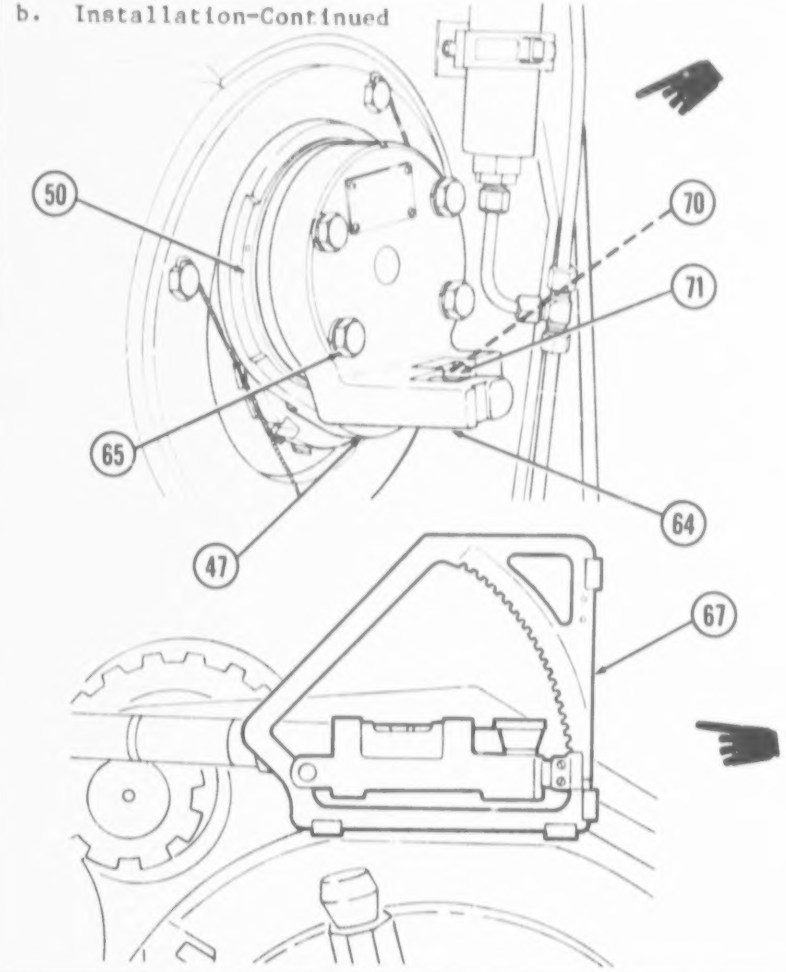
44 Drill and ream, as required, the two holes in the trunnion support bracket (47) and cannon trunnion (63) for new expansion pin assemblies (48).

45 Install two new expansion pin assemblies (48). Torque nuts on expansion pins to 9 lb-ft (12 N·m).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET – Continued

b. Installation-Continued



46 Install test gage (64) on trunnion support bracket (47) and torque mounting cap screws (65) to 20 lb-ft (27 N·m).

WARNING

RADIATION ☢ HAZARD

TRITIUM GAS (H3)

M1A1/M1A2 gunner's quadrant is radioactively illuminated. Refer to page b for safety warnings and procedures.

47 Place M1A1/M1A2 gunner's quadrant (67) on cant seats on breechblock. Bubble must be approximately centered. Remove gunner's quadrant. Observe bubble (70) in cross level vial (71) of test gage (64). Bubble (70) must be approximately centered. Mark exact position of bubble ends with a felt-tipped marker or grease pencil.

48 Elevate cannon to maximum elevation, observing bubble (70) continuously. Bubble (70) must remain stationary within 1/2 of a vial graduation. If bubble (70) does not remain stationary, note the amount of deviation, then proceed to realine the compensating taper ring (50) between trunnion support bracket (47) and test gage (64) as follows:

a With the weapon at maximum elevation, loosen four cap screws (65) securing test gage (64) to trunnion support bracket (47) just enough to loosen compensating taper ring (50) without disturbing position of bubble (70) in test gage (64).

b Insert blade of a thin screwdriver or other similar tool into one of the holes on circumference of compensating taper ring (50) and adjust position clockwise or counterclockwise so that one-half of deviation noted above is removed.

c Torque four cap screws (65) securing test gage to trunnion support bracket (47) to 20 lb-ft (27 N·m).

d Depress and elevate cannon through full travel while noting position of bubble (70) in cross level vial (71) of test gage (64). Bubble (70) must remain stationary as cannon is elevated and depressed through full travel. Repeat step 45 a, b and c until this condition prevails.

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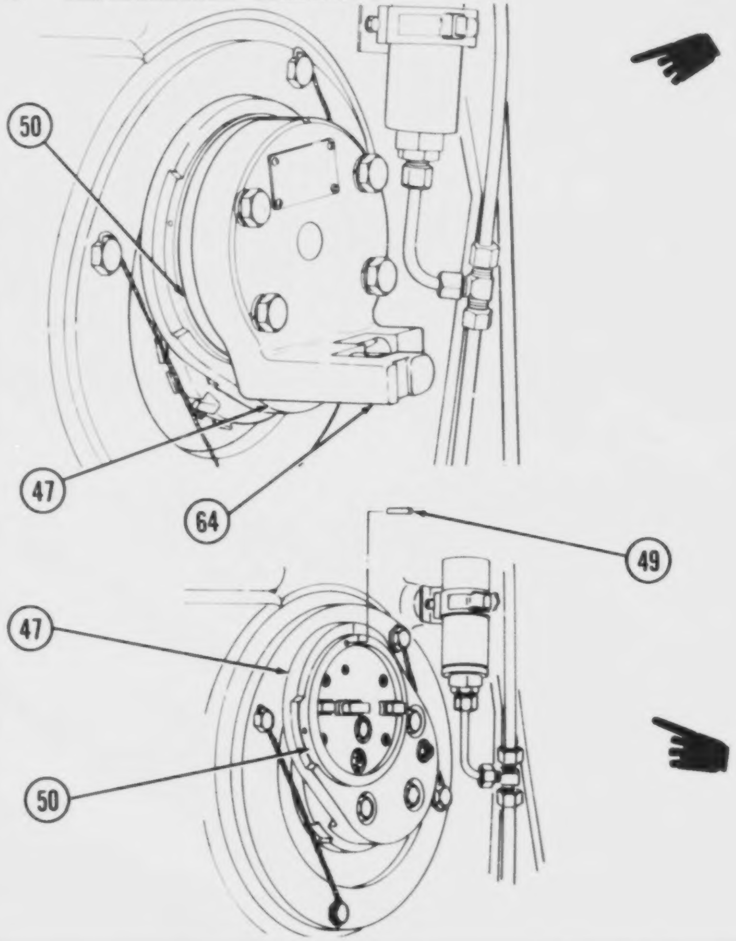
MOUNT AND HOWITZER ASSEMBLY — Continued

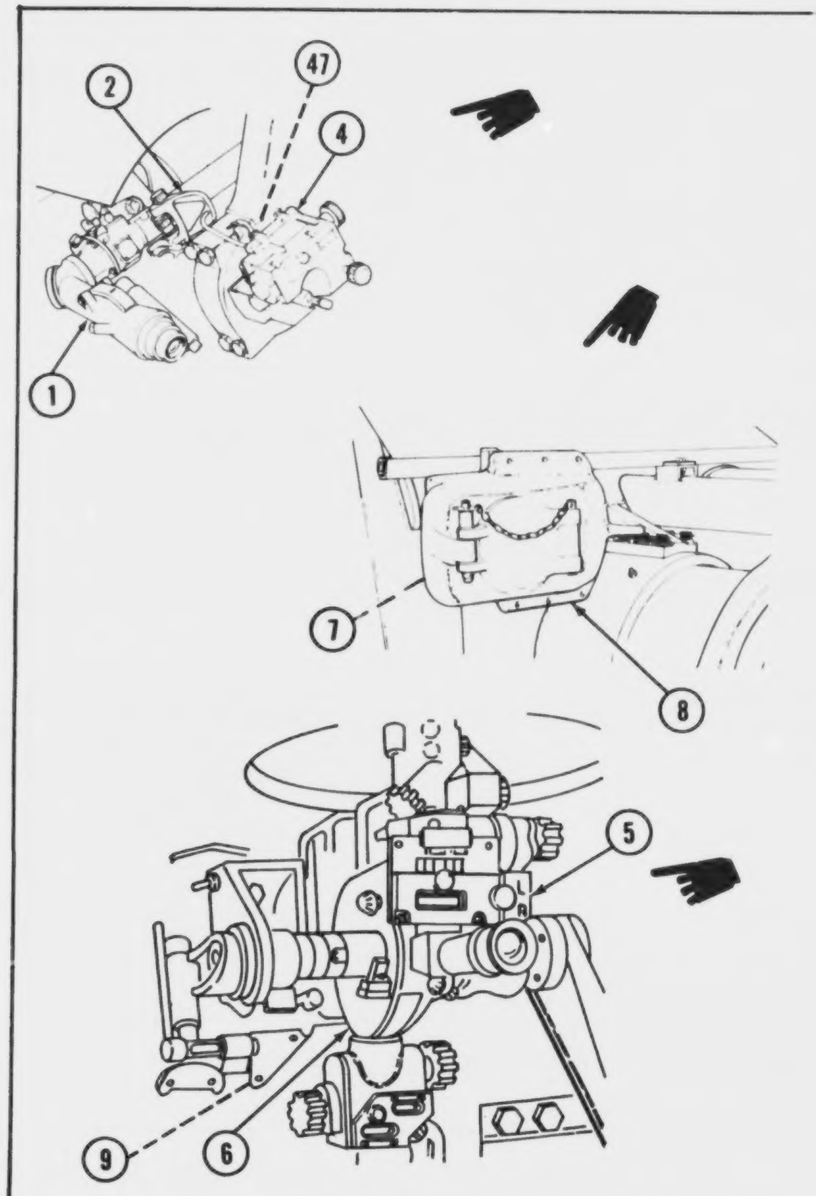
4-1. MOUNT AND HOWITZER WITH TRUNNION BRACKET — Continued

b. Installation-Continued



49 Mark location of taper ring (50) or secure taper ring (50) in position. Remove test gage (64) from trunnion support bracket (47).

50 Make sure taper ring (50) is in correct position. Drill and ream holes as required in trunnion support bracket (47) and compensating taper ring (50) for locating dowel pin (49). Install a new dowel pin (49).



51 Make certain that all mating surfaces are free of dirt or other foreign matter and install M15 elevation quadrant (4) on trunnion support bracket (47) (ref. TM 9-2350-311-20-2).

52 Install collimator control bracket (9) (ref. TM 9-2350-311-20-2).

53 Install offset periscope M42 (7) and cover (8) (ref. TM 9-2350-311-20-2).

54 Install mount M145 (6) and panoramic telescope M117/M117A2 (5) (ref. TM 9-2350-311-20-2). Aline panoramic telescope M117/M117A2 (5) with cannon bore (ref. TM 9-2350-311-10).

55 Install mount M146 (2) and elbow telescope M118A2 (1) (ref. TM 9-2350-311-20-2).

MOUNT AND HOWITZER ASSEMBLY

4-2. CANNON ASSEMBLY (CAB ON VEHICLE–METHOD ONE)

This task covers: a. Removal b. Installation

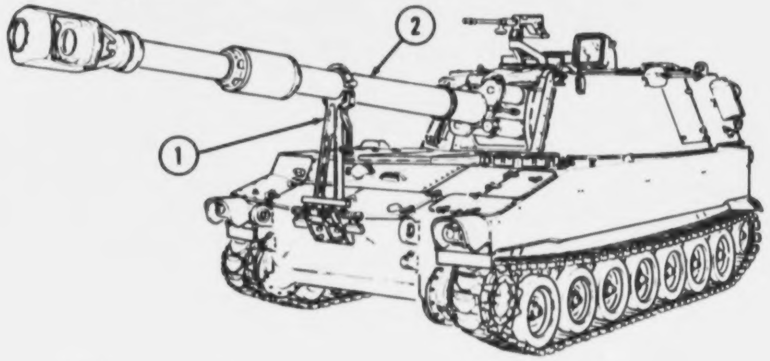
INITIAL SET-UP

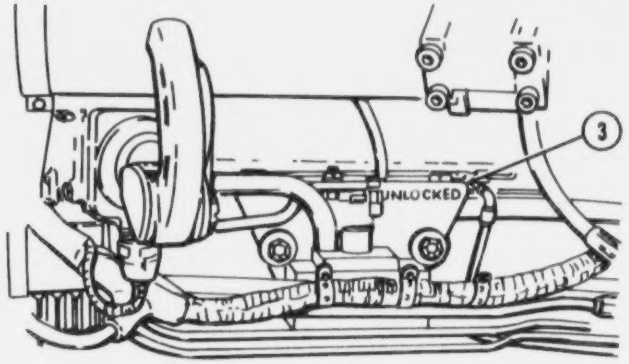
Special Tools
- Fabricated tray (App. E)
- Sling, gun tube (Item 6, App. B)
- Hoist (Item 2, App. B)
- Fabricated eyebolt assembly, muzzle (App. E)
- Fabricated eyebolt assembly, breech (App. E)
- 30-foot cable, hook at each end
- Wooden blocks
- Lever action chain hoist, 2-ton capacity
- Fabricated wedge blocks, bolts and pins, four sets
- Nitrogen charging kit

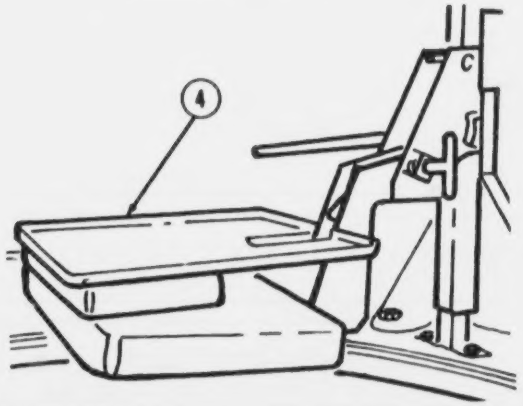
Materials/Parts
- Grease (Item 9, App. C)
- Cotter Pins
- Lock Washers
- Hydraulic Fluid (Item 10, App. C)
- Nitrogen (Item 18, App. C)

Personnel Required
3

a. Removal







WARNING

- Locate vehicle on level terrain with vehicle brake lock handle applied to avoid possible injury due to vehicular movement.
- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

1 Remove cannon travel lock (1) from cannon tube (2). Stow travel lock (1) (ref. TM 9-2350-311-10).

2 Center cannon tube (2) and elevate to 0 mils.

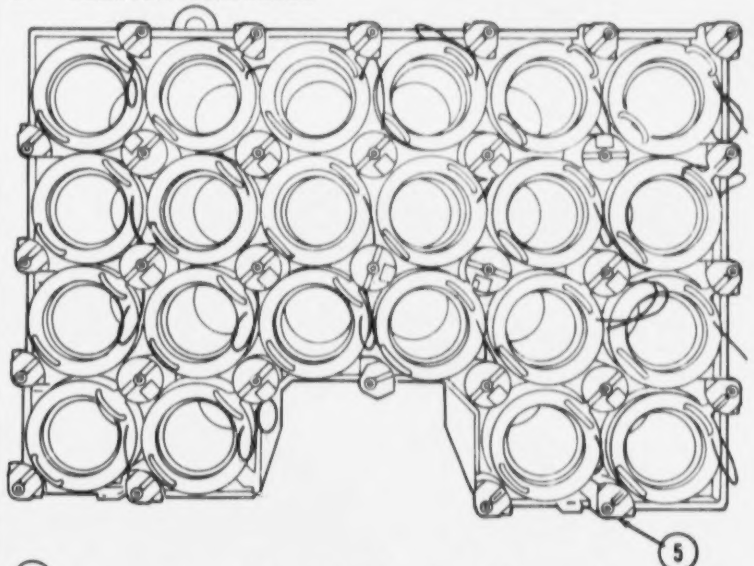
3 Place turret lock (3) in LOCKED position.

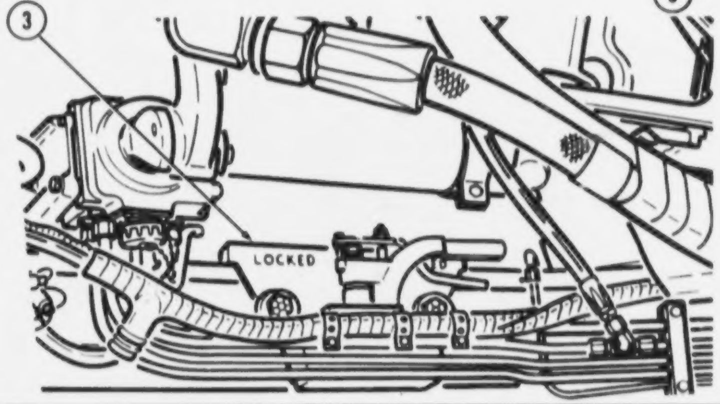
4 Stow and latch commander's seat (4).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD ONE) — Continued

a. Removal-Continued



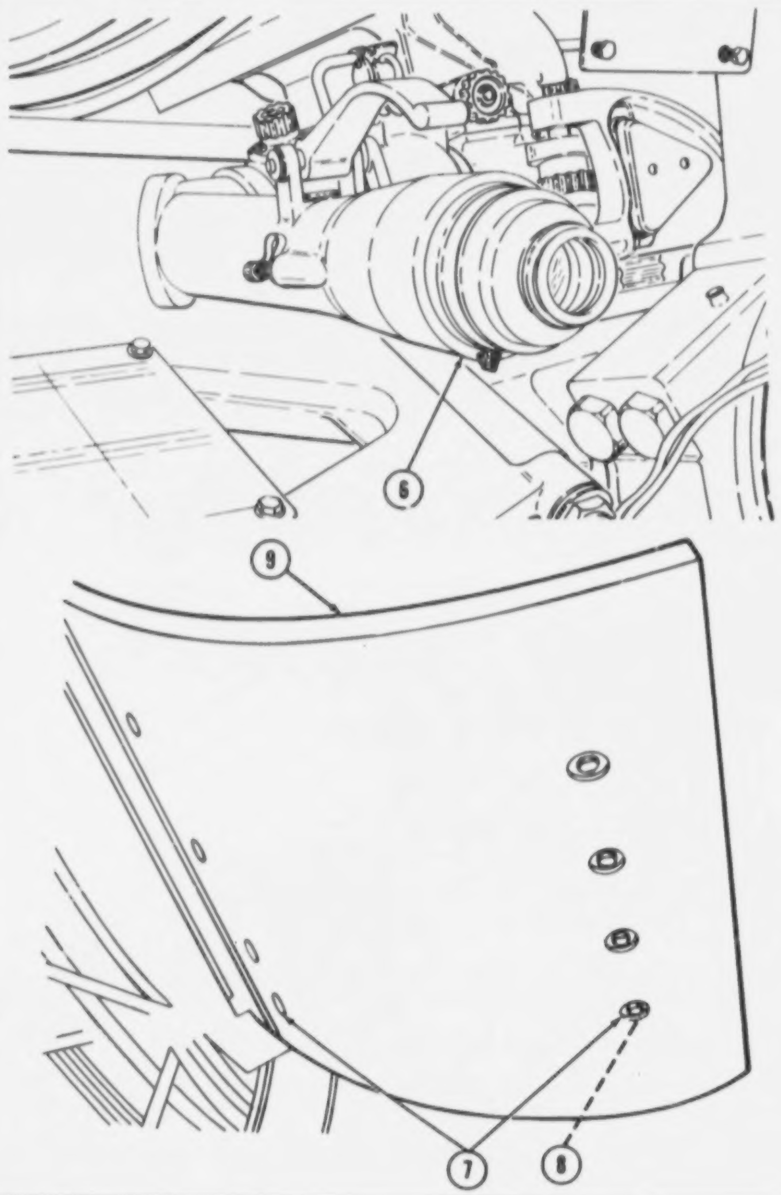


5 Remove cab ammunition rack (5) (ref. page 12-2).

CAUTION

Insure that bustle doors are closed to avoid damaging equipment while traversing cab. Cab will not clear driver's vision blocks with bustle doors open.

6 Release turret lock (3) and traverse cab manually 3200 mils. Then lock turret lock (3) again and open bustle doors.



WARNING

Support lower rotor during removal. Lower rotor weighs approximately 57 pounds (26 Kilograms) and may cause injury if dropped.

7 Remove elbow telescope M118A2 (6) (ref. TM 9-2350-311-20-2).

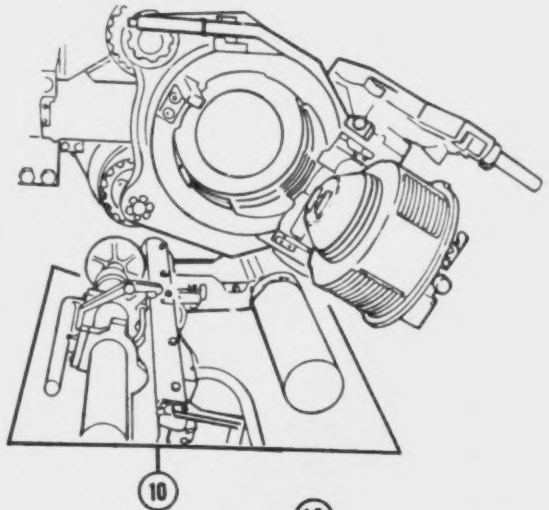
8 Remove eight socket head cap screws (7), eight lock washers (8) and lower gun shield (9).

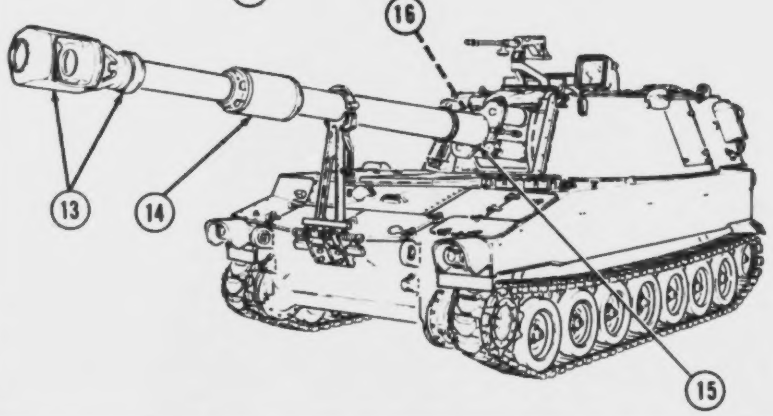
9 Discharge cab hydraulic pressure (ref. TM 9-2350-311-20-2).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE–METHOD ONE) — Continued

a. Removal-Continued





WARNING

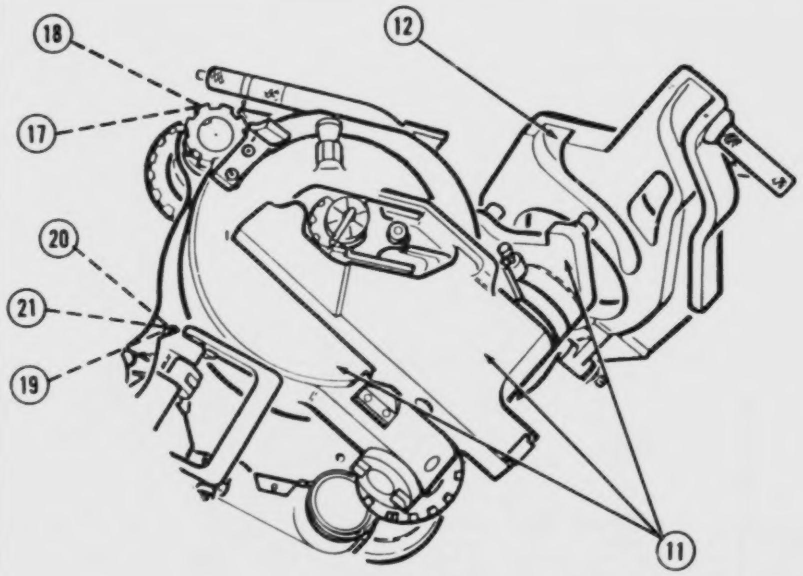
Rammer weighs 198 pounds (90 kilograms). Use three personnel to avoid injury.

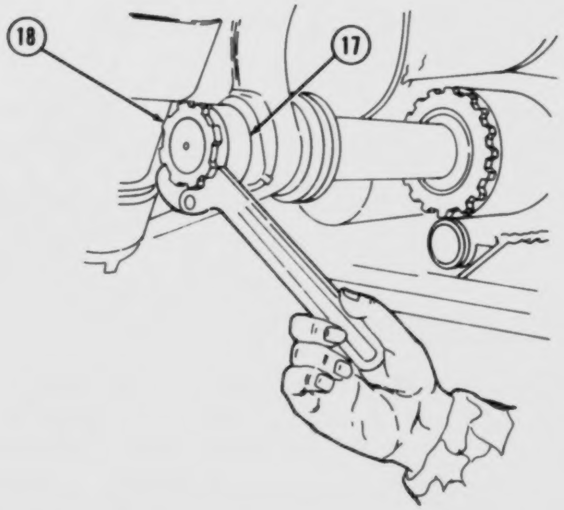
10 Remove rammer (10) and stow on cab floor directly beneath M178 howitzer mount (ref. page 6-4). Do not disconnect hydraulic hoses.

11 Remove damper assembly (not shown) (ref. page 4-100).

12 Secure breech mechanism operating cam (12) to ceiling, out of the way (ref. page 4-100).

13 Disassemble and remove breech mechanism (11) (ref. page 4-96).





14 Remove muzzle brake and thrust collar (13). Remove bore evacuator (14) (ref. page 4-77).

15 Remove mount dust shield group (15) (ref. page 4-80).

16 Remove torque key (16).

17 Unlock two key washers (17).

18 Remove two round nuts (18) from variable recoil cylinders using spanner wrench (ref. page 4-186).

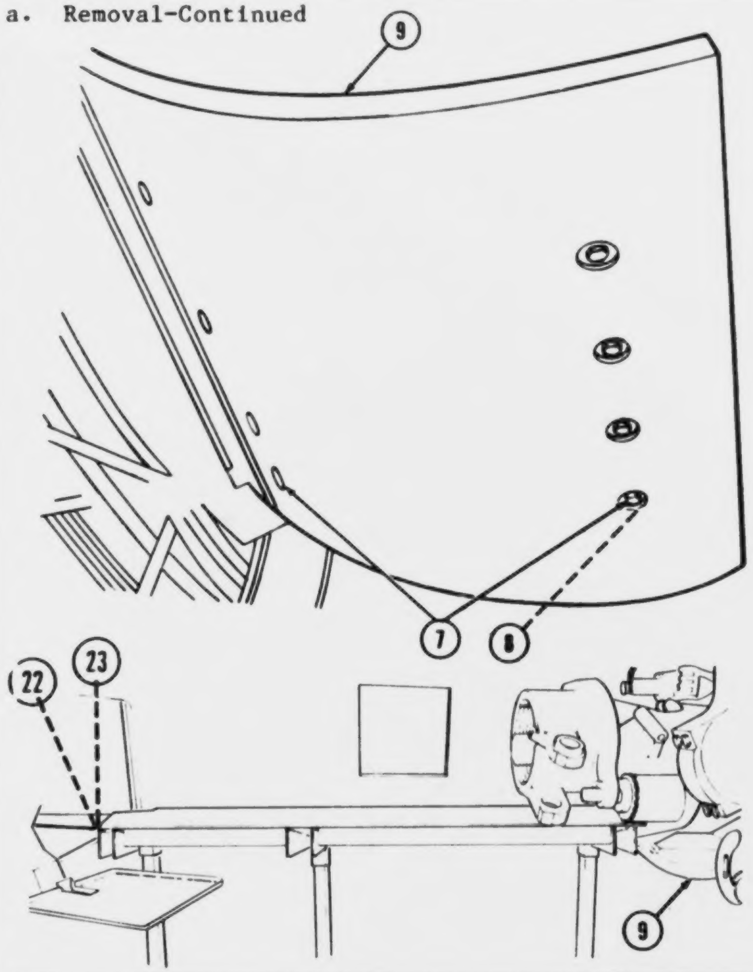
19 Release nitrogen pressure from recuperator (ref. page 4-147).

20 Remove cotter pin (19) and slotted nut (20) (not shown) from recuperator piston rod end (21).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE–METHOD ONE) — Continued

a. Removal-Continued



21 Using eight socket head cap screws (7) and eight lock washers (8), install lower gun shield (9).

22 Install fabricated tray (App. E) as follows:

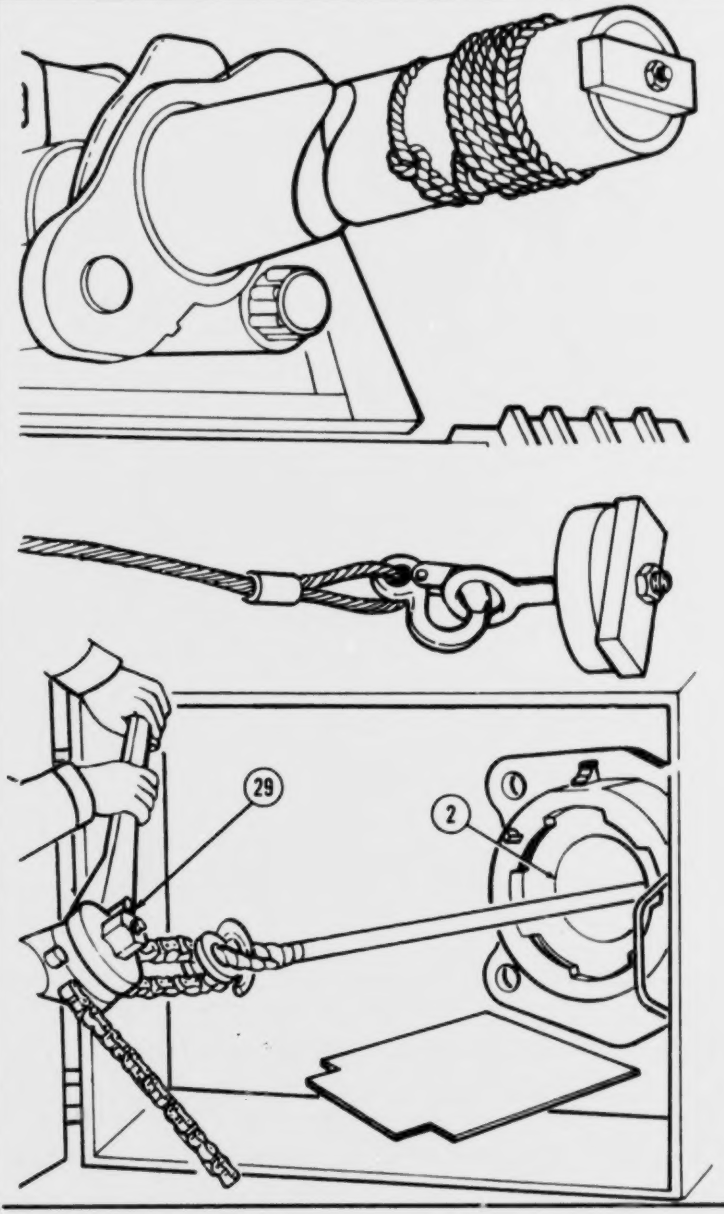
  a Remove two race ring bolts (not shown) on either side of fabricated tray (App. E) at rear of cab.

  b Secure fabricated tray and legs (App. E) to rear of cab surface by installing two washers (22) and two screws (23) through fabricated tray (App. E) and into rear cab surface.

  c Rest tabs on front of fabricated tray (App. E) on lower gun shield (9).

  d Lubricate sliding surface of fabricated tray (App. E) with grease (Item 9, App. C).

23 Drain all fluid from equilibrator manifold (ref. TM 9-2350-311-20-2).



24 Wrap cannon tube threads with rope to prevent damage.

25 Thread one end of 30-foot cable (with hooks on both ends) through cannon tube (2). Tie greased rag around hook to avoid damage to the lands.

26 Attach fabricated eyebolt and muzzle assembly (App. E) to cable hook at muzzle and draw cable taut. Seat eyebolt assembly (App. E) in muzzle as shown.

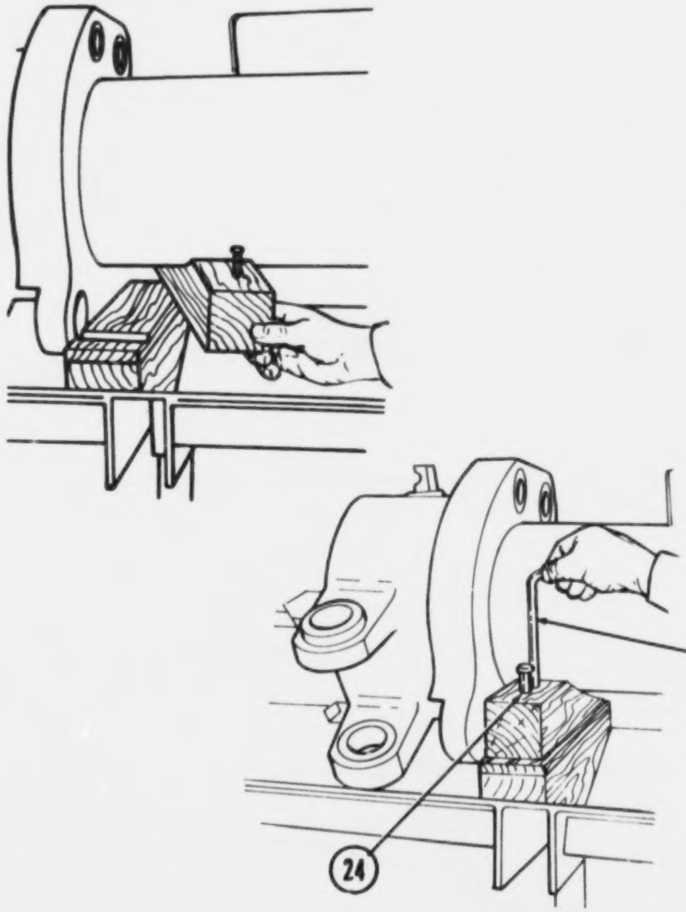
27 Attach lever action chain hoist (Item 2, App. B) to cable in cannon tube (2). Attach lever action chain hoist to solid external object or use wrecker.

28 Slide cannon tube (2) to rear 40 inches (1016 mm) (clear of variable recoil buffer assembly).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD ONE) — Continued

a. Removal-Continued

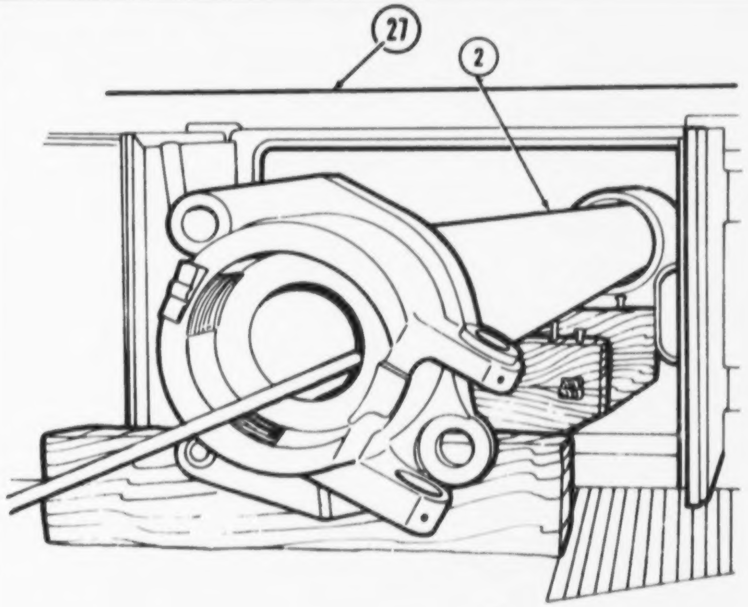


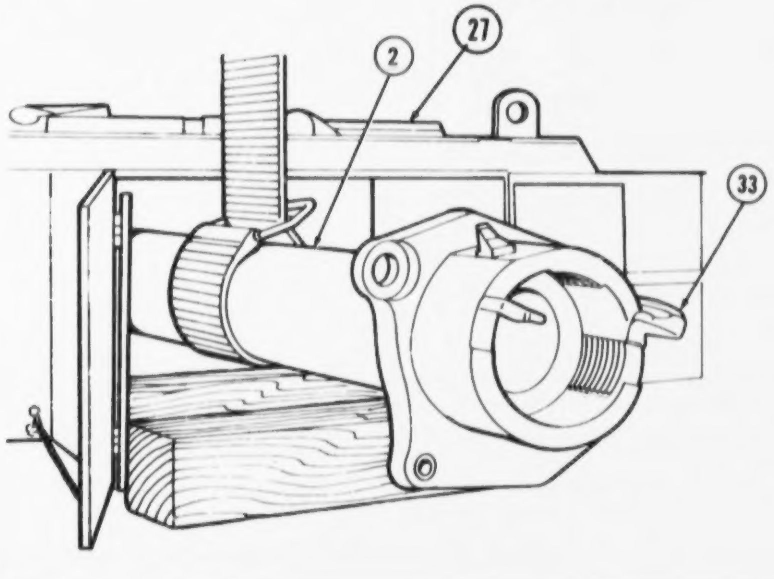
NOTE

Bolt adjusts wedge blocks to cannon. Any alinement of gun tube and tray can be accomplished by elevating or depressing cannon tube by attaching hoist to muzzle end of tube with sling.

29 Install two sets of wood wedge blocks, four bolts (24) and four pins (25) on each side of front cannon tube (2) and rear of cannon tube (2).

30 Make sure cannon tube (2) is clear of variable recoil buffer assembly and rotate so that lower lug on breech mechanism (26) clears fabricated tray (App. E).





31 Slide cannon tube (2) until center of balance (Approximately 98 inches (2489 mm) forward of rear face of breech ring band) is just clear of cab (27).

32 Place additional wooden block as illustrated to support cannon tube (2). Remove chain hoist and fabricated eyebolt (App. E).

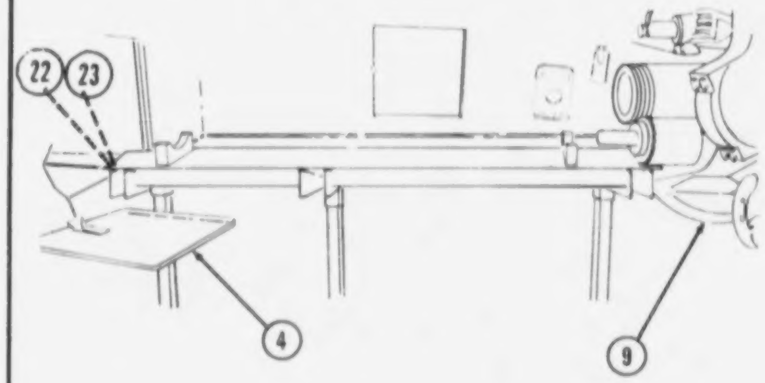
33 Attach gun tube sling (Item 6, App. B) to cannon at center of balance (center is marked on cannon tube (2)).

34 Withdraw cannon tube (2) from cab (27) and place on blocks or other suitable support on a hardened surface.

MOUNT AND HOWITZER ASSEMBLY

4-2. CANNON ASSEMBLY (CAB ON VEHICLE – METHOD ONE) – Continued

b. Installation



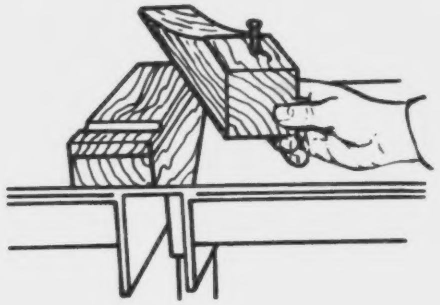
WARNING

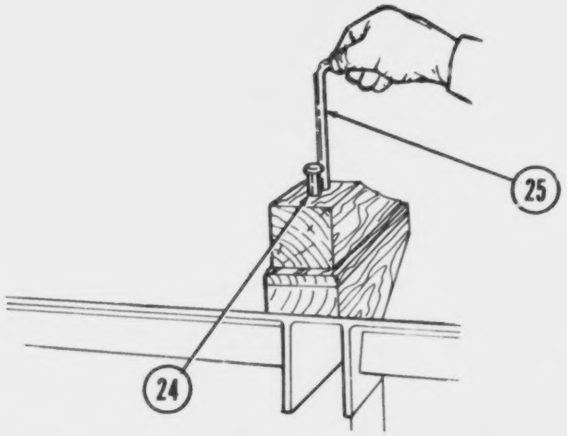
Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

NOTE

Cab must be facing rear of vehicle with turret lock in locked position.

1 Stow and latch commander's seat (4) (ref. TM 9-2350-311-10).





2 Install fabricated tray and legs (App. E) as follows:

a Remove two race ring bolts (not shown) on either side of fabricated tray (App. E) at rear of cab.

b Secure fabricated tray (App. E) to rear of cab surface by installing two washers (22) and two screws (23) through fabricated tray (App. E) and into rear cab surface.

c Rest tabs on front of fabricated tray (App. E) on lower gun shield (9).

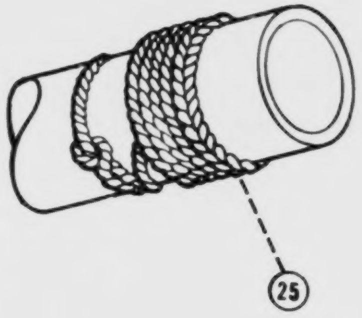
d Lubricate sliding surface of fabricated tray (App. E) with grease (Item 9, App. C).

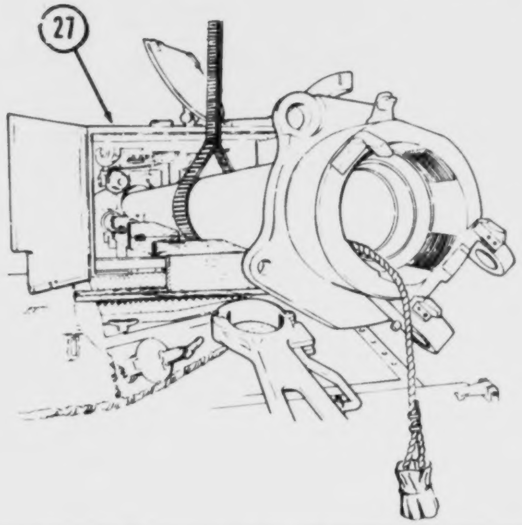
e Install two sets of wood wedge blocks, four bolts (24) and four pins (25) at front and rear of fabricated tray (App. E).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD ONE) — Continued

b. Installation-Continued



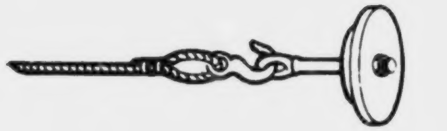


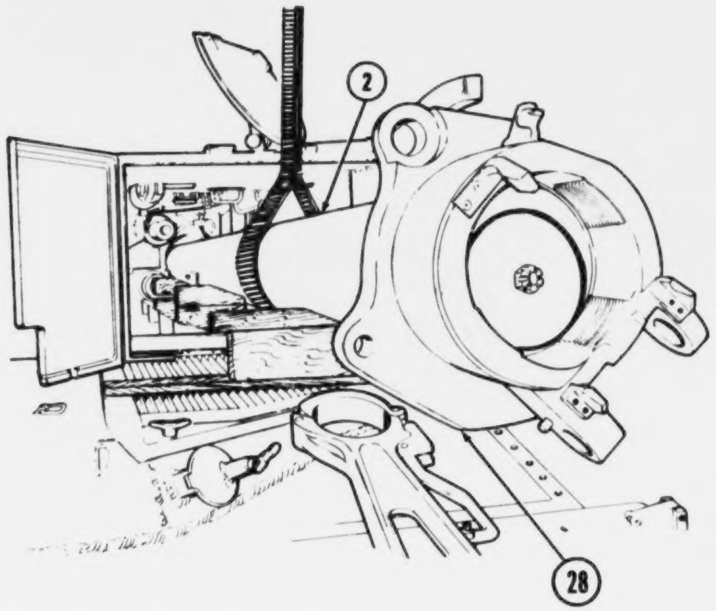
3 Wrap cannon tube threads (25) with rope to prevent damage.

4 Thread one end of 30-foot cable (with hooks on both ends) through cannon tube (2) and tie greased rag around hook to avoid damage to the lands.

5 Attach gun tube sling (Item 6, App. B) to cannon tube (2) at center of balance, (approximately 98 inches (2489 mm) forward of rear face of breech ring band).

6 Place cannon tube (2), muzzle first, into cab (27) and mount with breech end resting on wooden block.





7 Install and seat breech eyebolt assembly (App. E) in breech.

8 Attach lever action chain hoist (Item 2, App. B) (not shown) to front hook and solid object beyond vehicle.

9 Move gun tube sling (Item 6, App. B) aft to lift breech ring band (28) over wooden block. Pull cannon tube (2) forward and remove gun tube sling (Item 6, App. B) and wedge blocks.

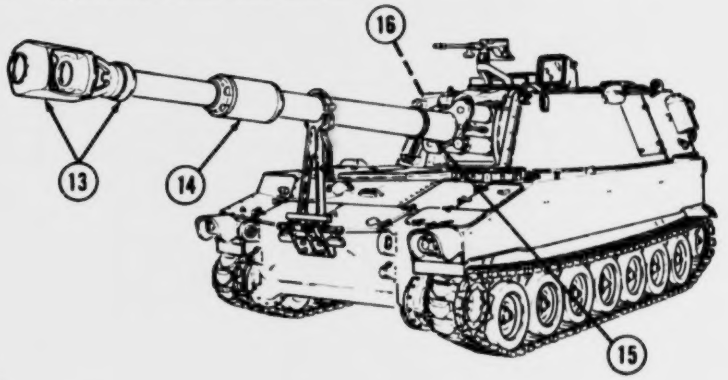
10 After cannon tube (2) clears fabricated tray (App. E), rotate cannon tube (2) as required to aline.

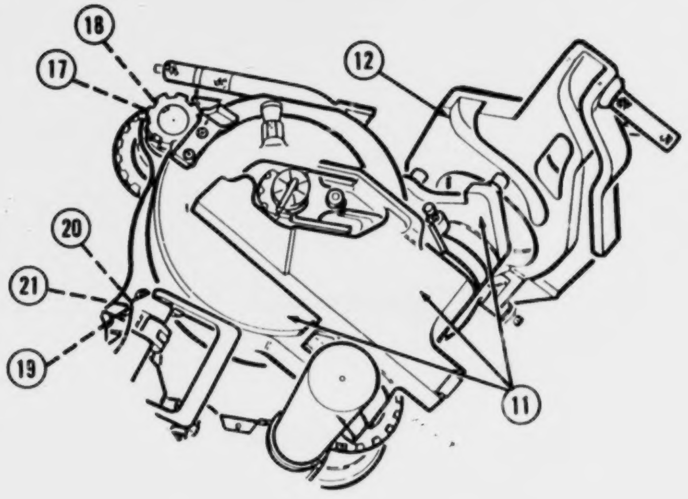
11 Pull cannon tube (2) into mount and remove gun tube sling (Item 6, App. B), rear breech eyebolt assemby (App. E), cable and rope.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE–METHOD ONE) – Continued

b. Installation-Continued





12 Install slotted nut (20) and cotter pin (19) on recuperator piston rod end (21).

13 Install two round nuts (18) on variable recoil cylinders using spanner wrench (ref. page 4-186).

14 Lock two key washers (17).

15 Recharge recuperator assembly with nitrogen refer to page 4-170)

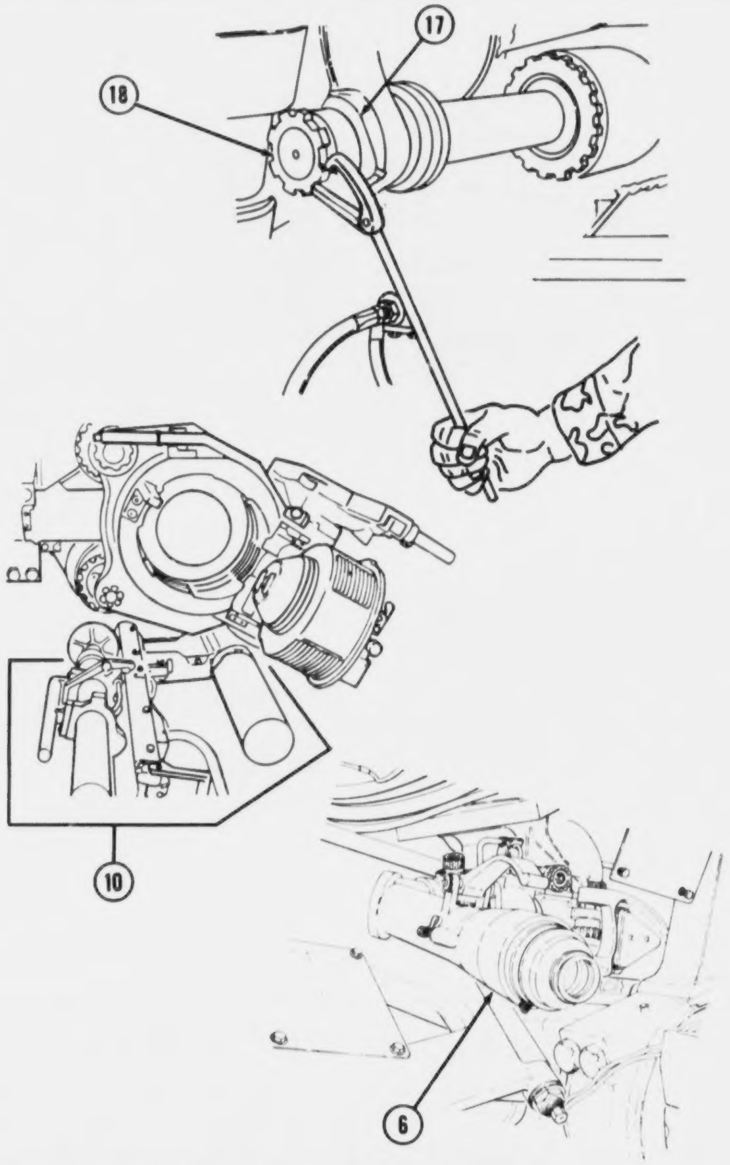
16 Replace torque key (16).

17 Install mount dust shield group (15) (ref. page 4-80).

18 Install bore evacuator (14). Install thrust collar and muzzle brake (13) (ref. page 4-77).

19 Assemble and install breech mechanism (11) (ref. page 4-96).

20 Release breech mechanism operating cam (12) from secured position on ceiling and install (ref. page 4-96).



21 Install weapon-mounted rammer (10) (ref. page 6-21).

22 Charge cab hydraulic system pressure refer to TM 9-2350-311-20-2.

23 Install elbow telescope M118A2 (6) (ref. TM 9-2350-311-20-2).

24 Equilibrate elevation system refer to TM 9-2350-311-20-2.

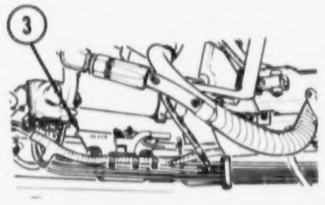
NOTE

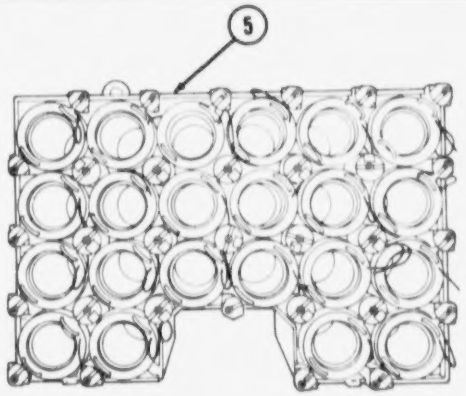
- After cannon assembly replacement, all fire control components must be checked for Bore Alinement refer to TM 9-2350-311-10 and TM 9-2350-311-20-2.
- Adjustment of Cam Roller Clearance is required after cannon assembly replacement refer to TM 9-2350-311-20-2.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE–METHOD ONE) – Continued

b. Installation-Continued





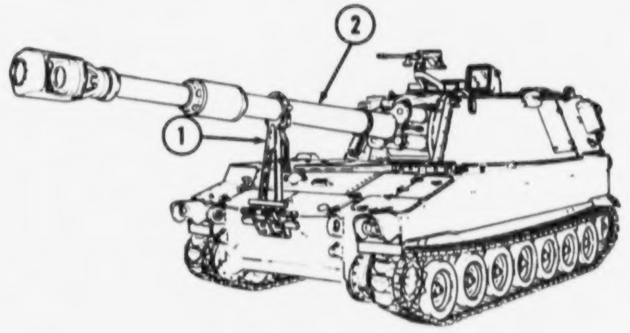
CAUTION

Insure that bustle doors are closed to avoid damaging equipment while traversing cab. Cab will not clear driver's vision blocks with bustle doors open.

25 Release turret lock (3) and traverse cab 3200 mils. Lock turret lock (3).

26 Install cab ammunition rack (5) (ref. page 12-2).

27 Place cannon (2) in travel lock (1). refer to TM 9-2350-311-10.



4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO)

This task covers: a. Removal b. Installation

INITIAL SET-UP

Materials/Parts

Nitrogen (Item 18, App. C)
Hydraulic fluid (Item 10, App. C)

Special Tools

Sling, gun tube (Item 6, App. B)
Hoist
Fabricated lifting eye bracket (App. E)
Fabricated lifting arm (App. E)
Wooden blocks
Fabricated breech stand (App. E)
Nitrogen charging kit (Item 11, App. B)

Personnel Required

3

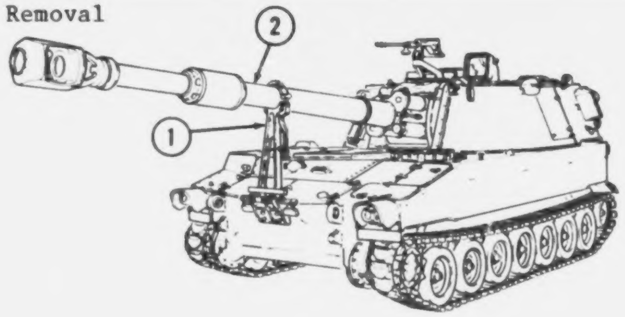
WARNING

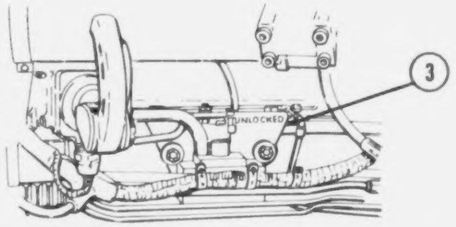
- Locate vehicle on level terrain with vehicle brake lock handle applied to avoid possible injury due to vehicular movement.
- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

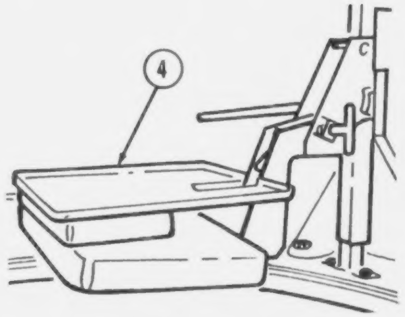
MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO) — Continued

a. Removal







WARNING

- Locate vehicle on level terrain with vehicle brake lock handle applied to avoid possible injury due to vehicular movement.
- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

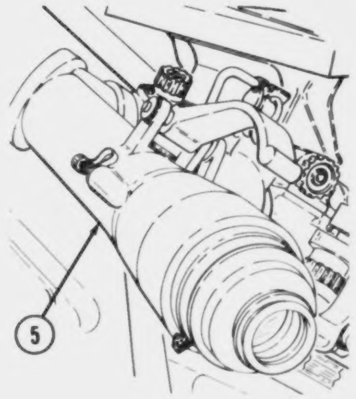
1 Remove cannon travel lock (1) from cannon tube (2) and stow cannon travel lock (1) (ref. to TM 9-2350-311-10).

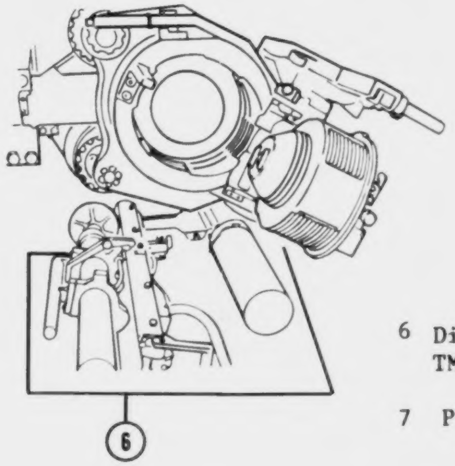
2 Center cannon tube (2) and depress to 0 mils.

3 Place turret lock (3) in LOCKED position.

4 Stow and latch commander's seat (4).

5 Remove M118A2 elbow telescope (5) (ref. TM 9-2350-311-20-2).



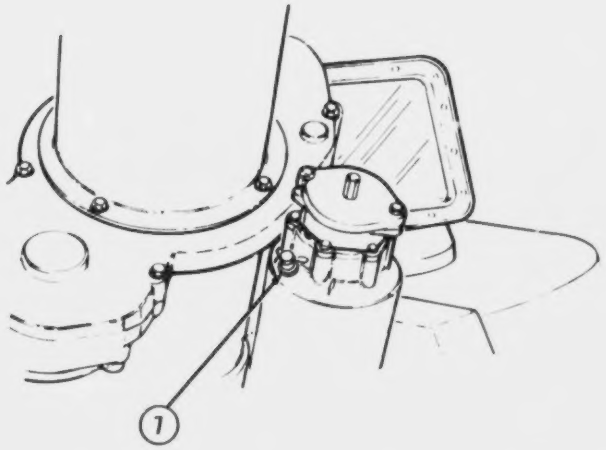


6 Discharge cab hydraulic system pressure (ref. TM 9-2350-311-20-2).

7 Place rammer (6) in stowed position.

WARNING

Cannon is shown elevated only for clarification. Cannon must be at 0 mils elevation when discharging nitrogen precharge pressure from recuperator cylinder to avoid possible injury due to cannon slipping out of battery.

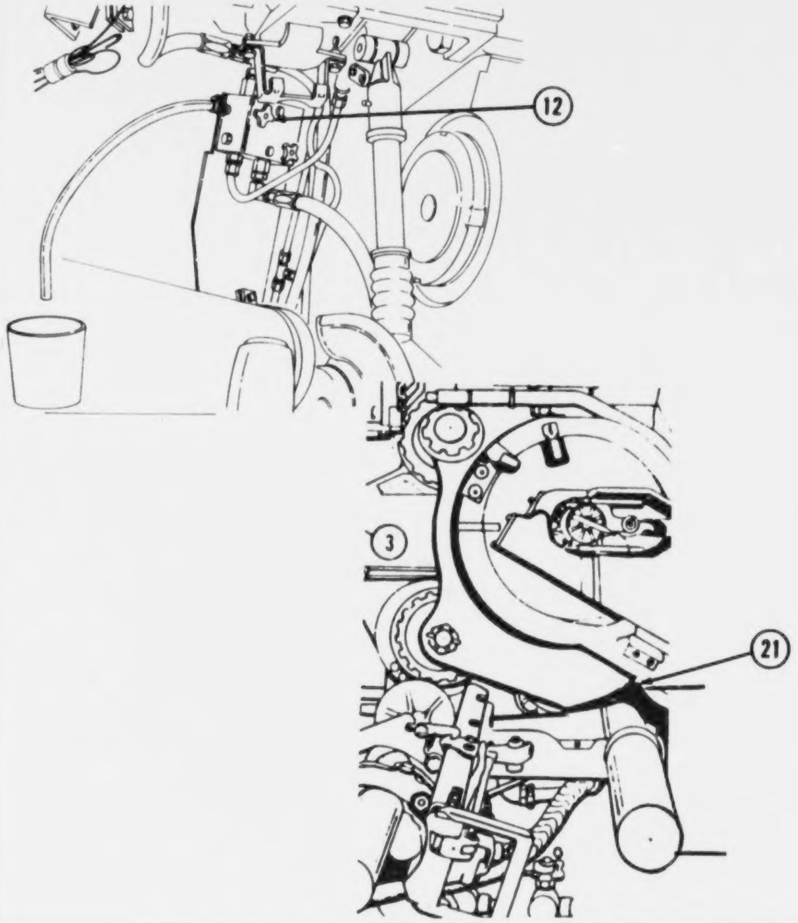


8 Bleed nitrogen from recuperator cylinder at valve (7) (ref. TM 9-2350-311-20-2).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO) — Continued

a. Removal-Continued

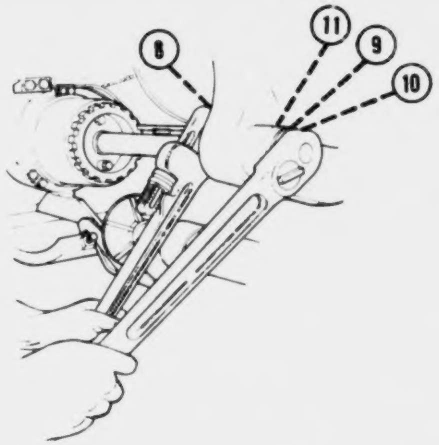


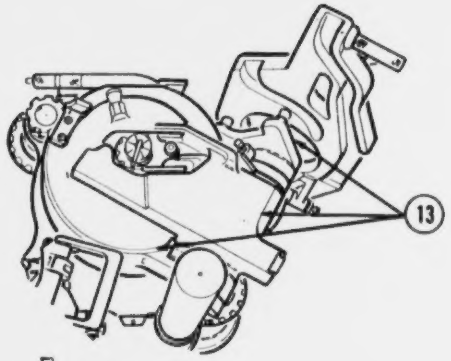
WARNING

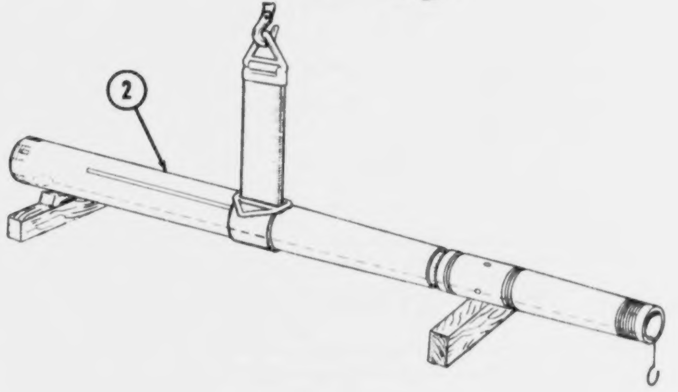
When working on mount and cannon breech components with cannon pushed out of battery, block cannon by placing fabricated breech stand (App. E) under breech body to prevent accidental elevation of cannon and possible injury to personnel or damage to equipment.

9 Push cannon tube (2) out of battery approximately 24 inches (609 mm) (ref. TM 9-2350-311-20-2) and place breech stand (ref. App. E) beneath breech ring body (21).

10 Drain all fluid from equilibration system (12) (ref. TM 9-2350-311-20-2).







11 While holding collar (8) with pipe wrench, remove cotter pin (9) and slotted nut (10) from recuperator piston rod end (11).

NOTE

Cannon assembly can be removed with or without disassembling all breech mechanism components.

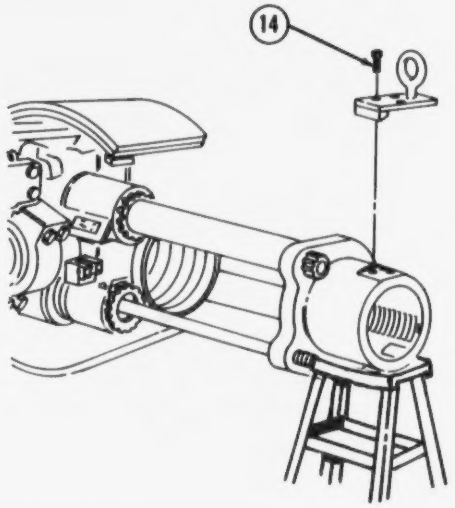
12 Remove breech mechanism components (13) if required (ref. page 4-96).

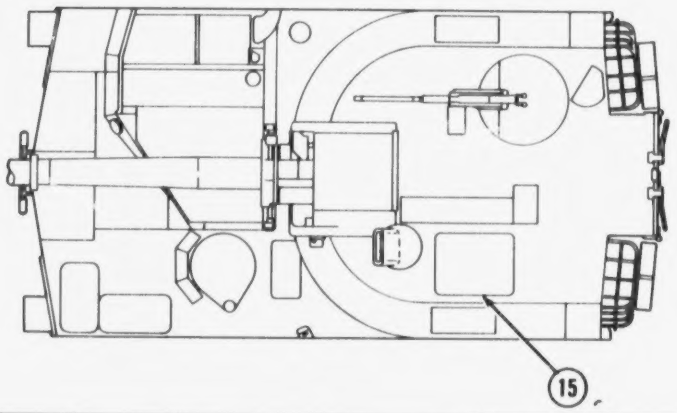
13 Remove cannon tube (ref. page 4-79).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO) — Continued

a. Removal-Continued





NOTE

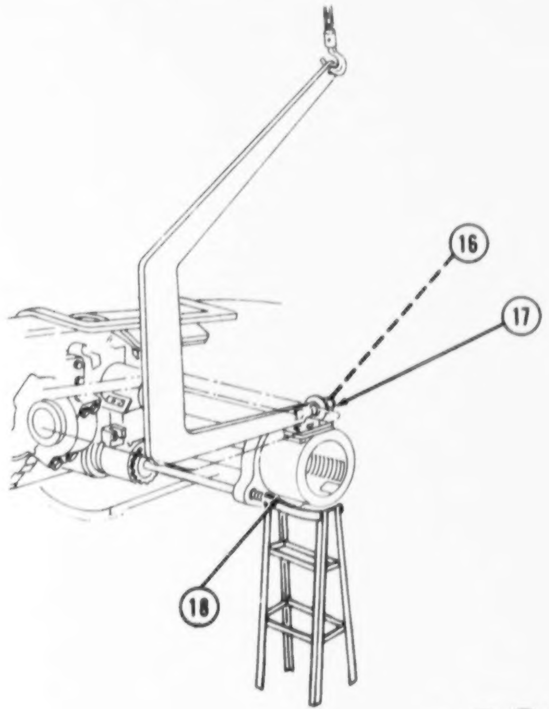
Breech ring body can be removed without removing rammer. Rammer not illustrated for clarification only.

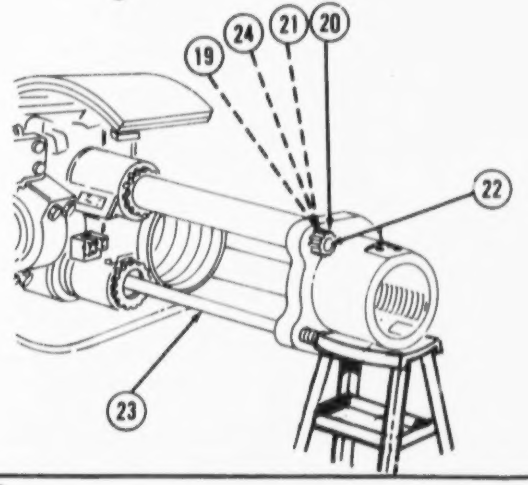
14 Remove operating handle stop (not shown) (ref. page 4-110).

15 Install fabricated lifting eye bracket (App. E) and three screws (14) in place of operating handle stop. Use three screws (14) from operating handle stop.

16 Insert fabricated lifting arm (App. E) through gunner's escape hatch (15). Attach to lifting eye bracket with flat washer (16) and nut (17) for 1-1/4 in.-12 NF thread.

17 Support weight of breech ring body (18) with fabricated lifting arm (App. E) and sling and hoist.





18 Bend tabs of two key washers (19) to disengage from slots of two round nuts (20).

19 Remove two round nuts (20), two key washers (19) and two key assemblies (21) from variable recoil cylinder rods (22).

WARNING

Maintain tension on hoist and lifting arm when removing breech to prevent injury to personnel or damage to equipment.

20 Remove breech ring stand from breech ring body (18).

CAUTION

Use care when removing breech ring to prevent damage to rammer assembly.

21 Remove breech ring body (18) from variable recoil cylinder rods (22) and recuperator rod (23) and lower to floor of vehicle.

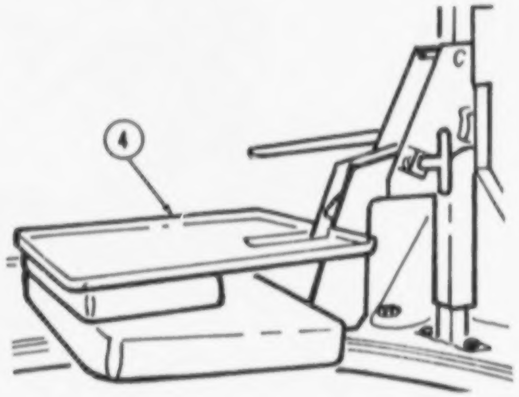
22 Remove two sleeve spacers (24) from variable recoil cylinder rods (22).

23 Remove fabricated lifting arm (App. E) from breech ring body (18) and raise through gunner's escape hatch (15). Remove fabricated lifting arm from sling and hoist.

24 Attach breech ring body (18) to sling and hoist. Lift out through gunner's escape hatch (15) or through rear hull door (not shown).

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO) — Continued

b. Installation



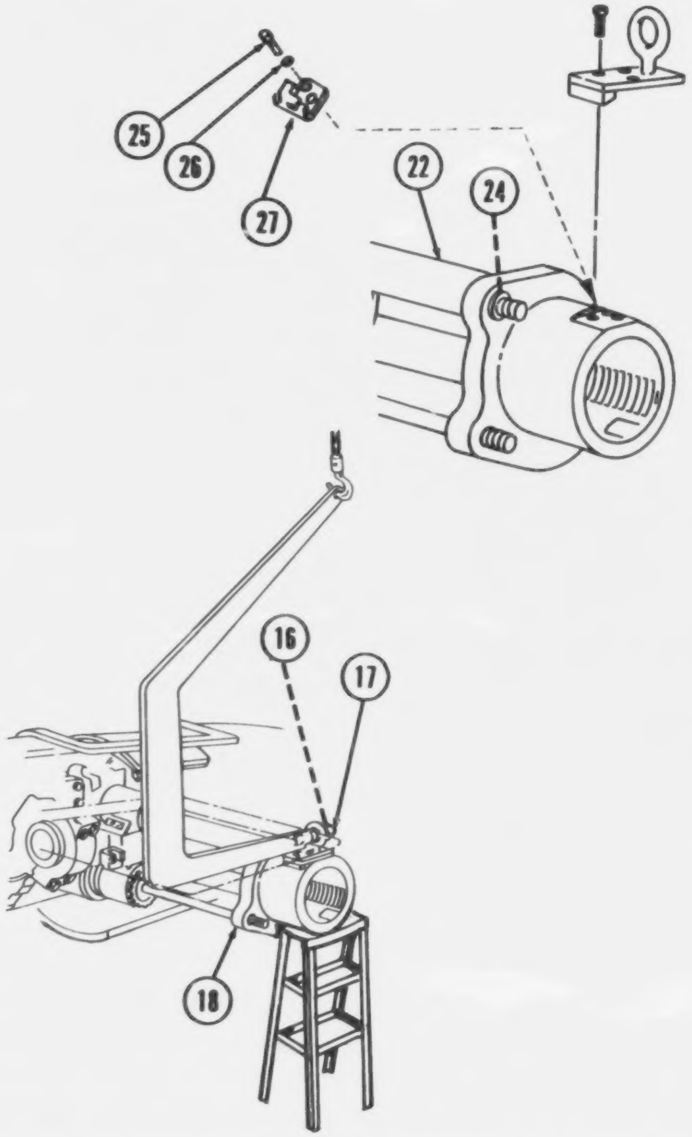
WARNING

- Locate vehicle on level terrain with brake lock handle applied to avoid possible injury due to vehicular movement.
- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

NOTE

Cab must be facing front of vehicle with turret lock in LOCKED position.

1 Stow and latch commander's seat (4).



2 Remove screws (25), washers (26) and operating handle stop (27) and install lifting eye bracket using screws (25).

3 Attach breech ring body (18) to sling and hoist. Lower onto floor of vehicle through gunner's escape hatch (15) or hull rear door.

4 Detach sling and hoist from breech ring body (18). Attach fabricated lifting arm (App. E) to sling and hoist and lower through gunner's escape hatch (15).

5 Attach end of fabricated lifting arm (App. E) to lifting eye bracket (App. E) on breech ring body (18) with flat washer (16) and nut (17) for 1-1/4 in.-12 NF thread.

6 Install sleeve spacers (24) onto variable recoil cylinder rods (22).

CAUTION

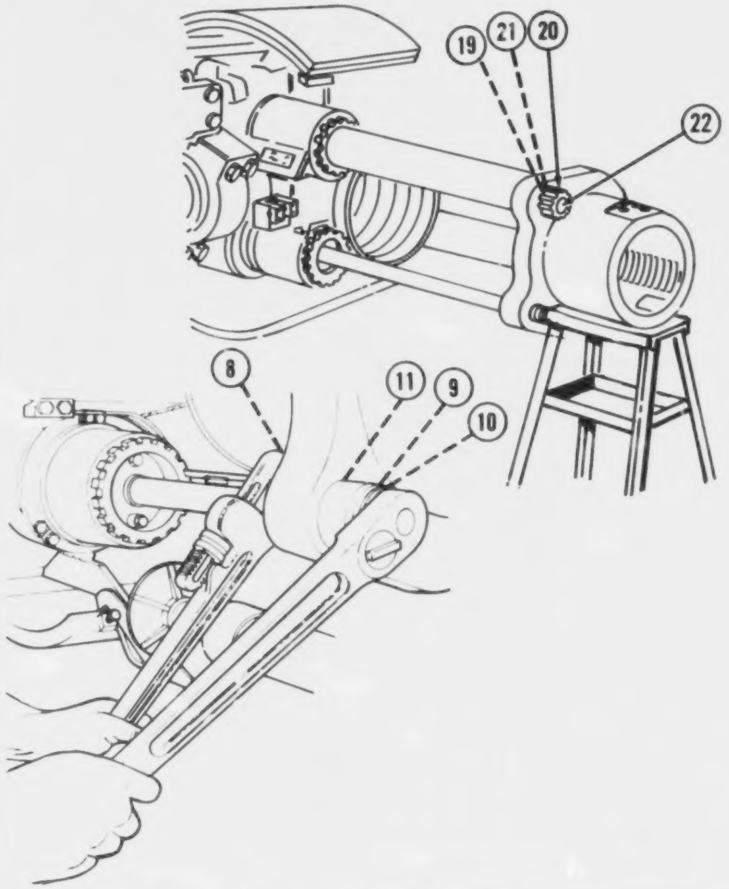
Use care to prevent breech ring body from damaging rammer assembly.

7 Lift and install breech ring body (18) onto variable recoil cylinder rods (22) and recuperator rods (23).

MOUNT AND HOWITZER ASSEMBLY — Continued

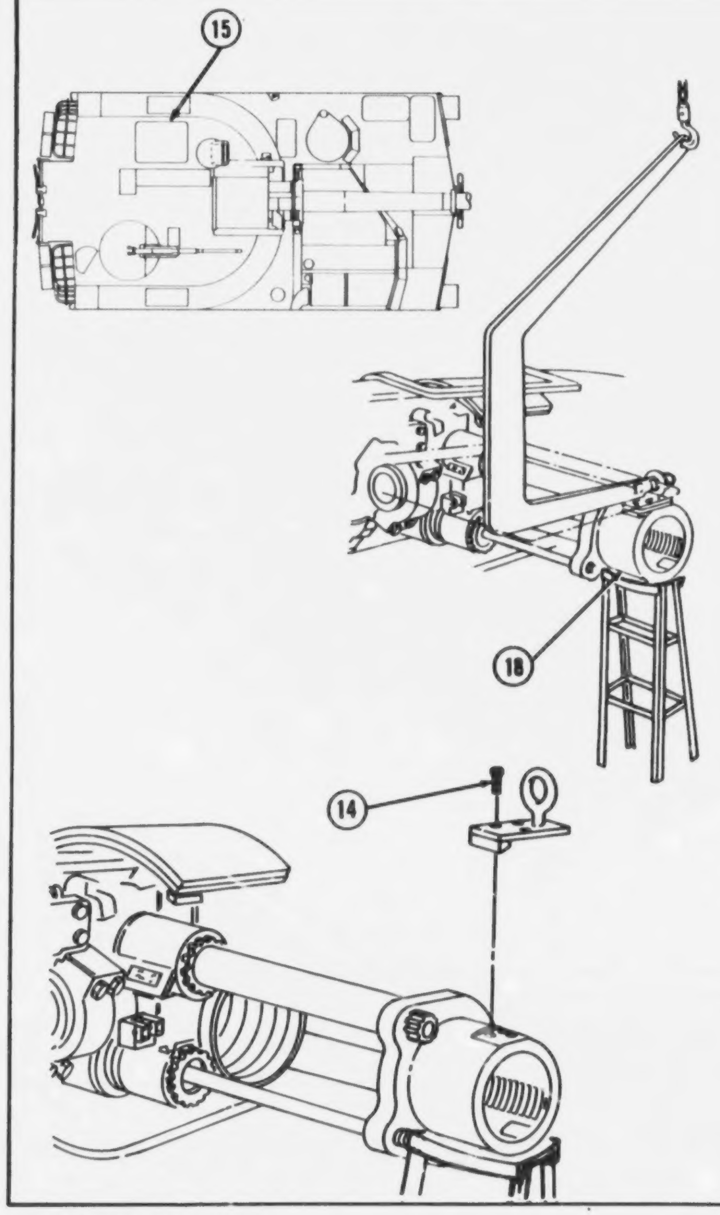
4-2. CANNON ASSEMBLY (CAB ON VEHICLE–METHOD TWO) – Continued

b. Installation-Continued



8 Install two key assemblies (21), two key washers (19) and two round nuts (20) onto variable recoil cylinder rods (22).

9 While holding collar (8) with pipe wrench, install slotted nut (10) and cotter pin (9) on recuperator piston rod end (11).



WARNING

When working on mount and cannon breech components with cannon pushed out of battery, block cannon with fabricated breech stand (App. E) under breech ring body to prevent accidental elevation of cannon and possible injury to personnel or damage to equipment.

10 Install breech stand into position under breech ring body (18) to hold mount in position.

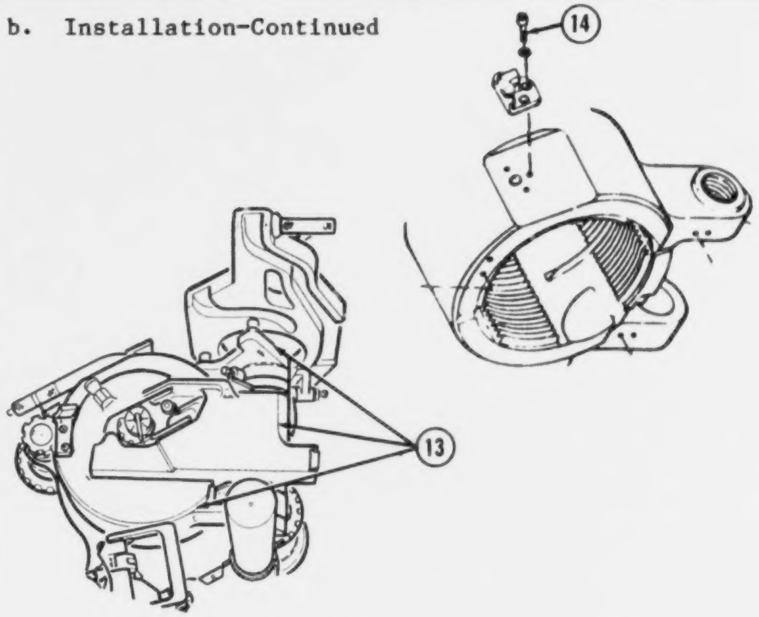
11 Remove fabricated lifting arm from breech ring body (18) and raise through gunner's escape hatch (15).

12 Remove fabricated lifting eye bracket and three screws (14) from top of breech ring body (18).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO) — Continued

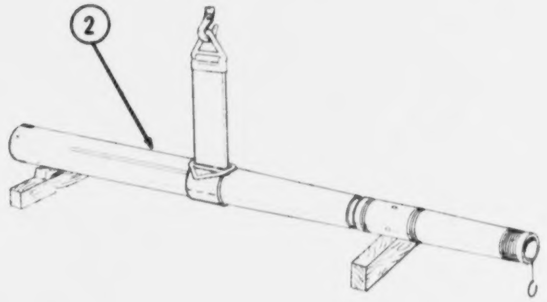
b. Installation-Continued

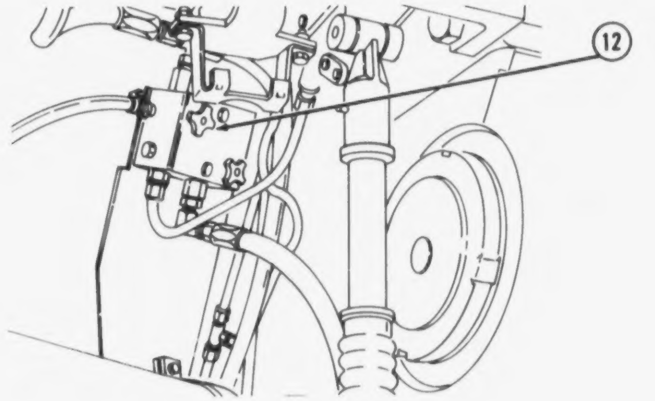


12 Install breech ring operating handle stop using three screws (14) from fabricated lifting eye bracket (App. E).

13 Install breech mechanism components (13) (ref. page 4-110) if removed.

14 Install cannon tube (2).





15 Fill equilibration system (12) with hydraulic fluid (Item 10, App. C) (ref. TM 9-2350-311-20-1).

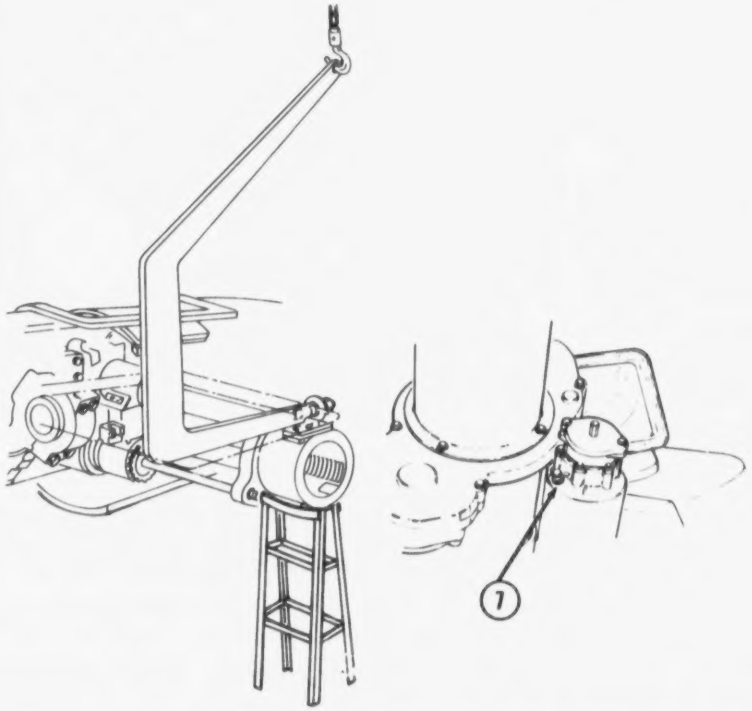
16 Remove breech stand from under breech ring body.

WARNING

To avoid being injured by moving parts, keep personnel clear of mount and howitzer when filling recuperator cylinder.

NOTE

Cannon will return to battery when recuperator cylinder is filled with nitrogen.

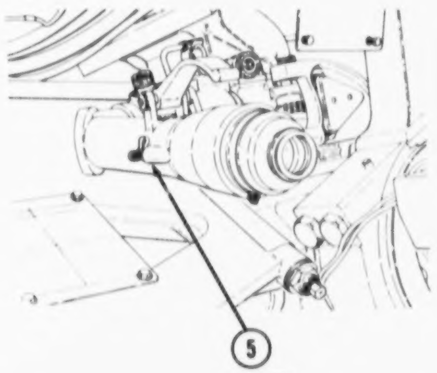


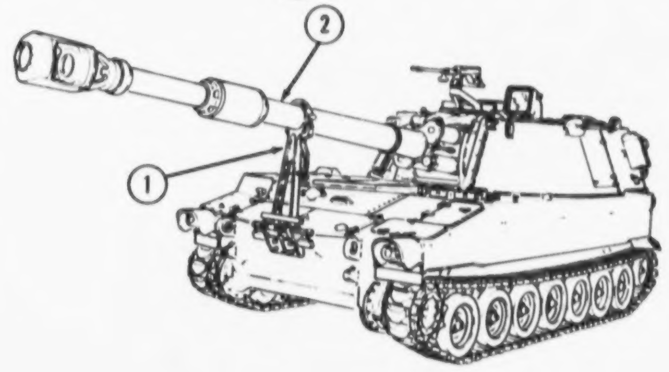
17 Using nitrogen (Item 18 App. C), fill recuperator cylinder at valve (7) (ref. page 4-170).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (CAB ON VEHICLE—METHOD TWO) — Continued

b. Installation-Continued





18 Install M118A2 elbow telescope (5) (ref. TM 9-2350-311-20-2).

NOTE

- After cannon assembly replacement all fire control components must be checked for bore alinement (ref. TM 9-2350-311-20-2).
- Adjustment or cam roller clearance is required after cannon assembly replacement (ref. TM 9-2350-311-20-2).

19 Place cannon tube (2) in travel lock (1).

4-2. CANNON ASSEMBLY (MOUNT OFF CAB)

This task covers: a. Disassembly b. Assembly

INITIAL SET-UP

Materials/Parts	Special Tools	Personnel Required
Cotter Pin	Sling Sling, gun tube (Item 6, App. B) Wooden blocks Spanner wrench	3

a. Disassembly

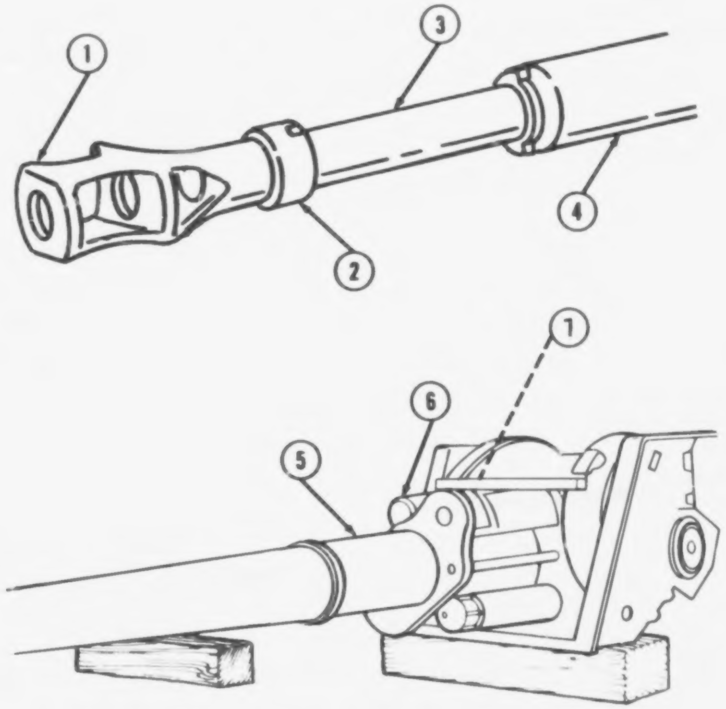
WARNING

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (MOUNT OFF CAB) — Continued

a. Disassembly-Continued



NOTE
Trunnion bracket does not have to be removed for cannon removal.

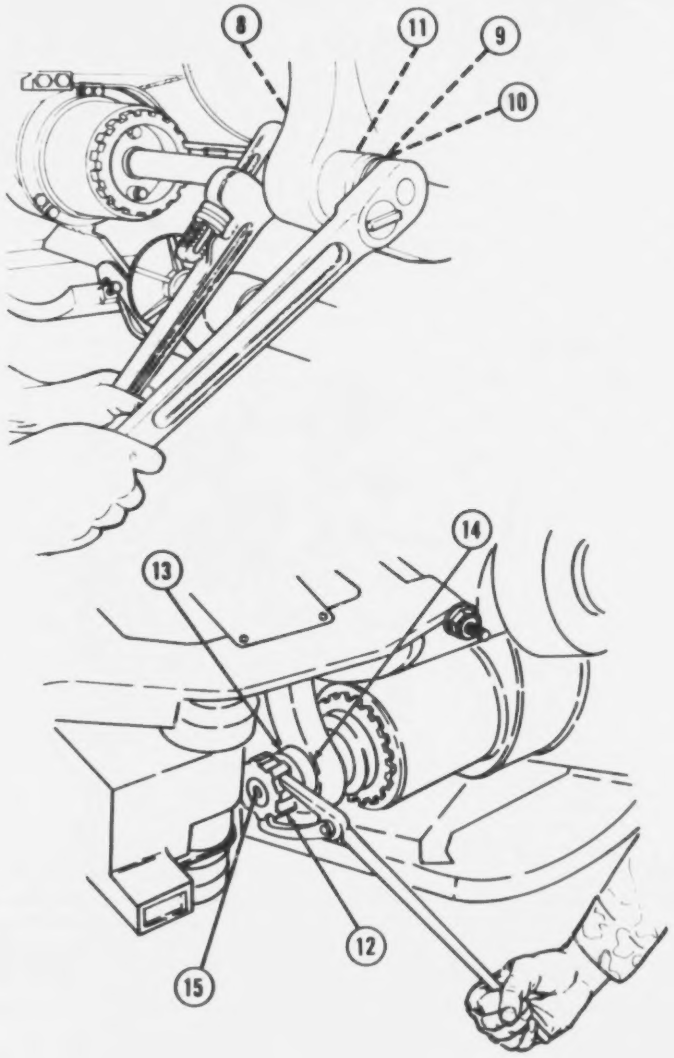
1 Remove muzzle brake (1) and thrust collar (2) from cannon assembly (3) (ref. page 4-72).

2 Remove bore evacuator (4) from cannon assembly (3) (ref. page 4-76).

3 Remove dust shield (5) from variable recoil housing (6) (ref. page 4-94).

4 Remove torque key (7) from base of cannon assembly (3) at mount.

5 Release nitrogen pressure from recuperator assembly (ref. page 4-146).



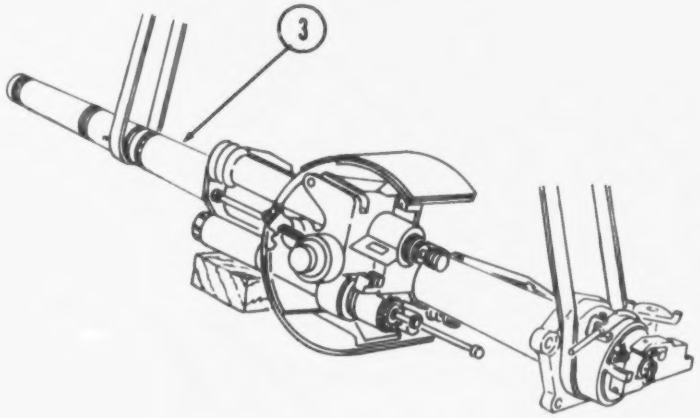
6 While holding collar (8) with pipe wrench, remove cotter pin (9) and slotted nut (10) from recuperator piston rod end (11). Discard cotter pin (9).

7 Unlock two key washers (13), remove two round nuts (12), two key washers (13) and two ring keys (14) from two variable recoil cylinder rods (15) using spanner wrench.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (MOUNT OFF VEHICLE) — Continued

a. Disassembly-Continued

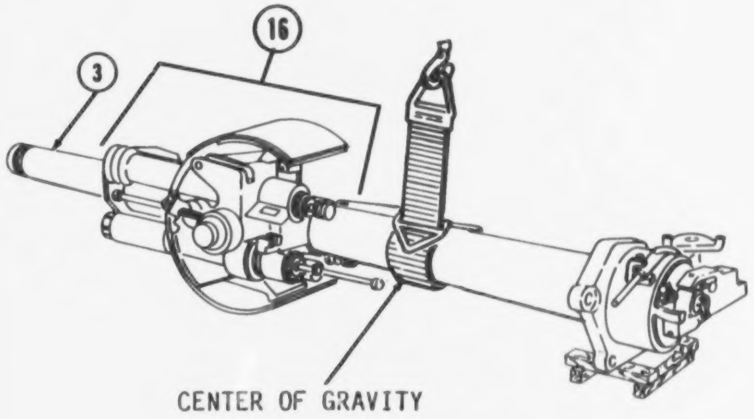


8 Attach two slings to cannon assembly (3) and to hoist (Item 2, App. B).

9 Raise hoist to remove slack from sling and slide cannon assembly (3) rearward three feet (914 mm).

10 Lower cannon assembly (3) and mount (16) as an assembly onto blocks.

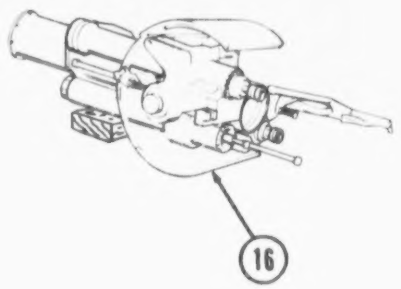
11 Remove two slings and attach single sling (Item 6, App. B) to cannon assembly (3) at center of gravity as shown.

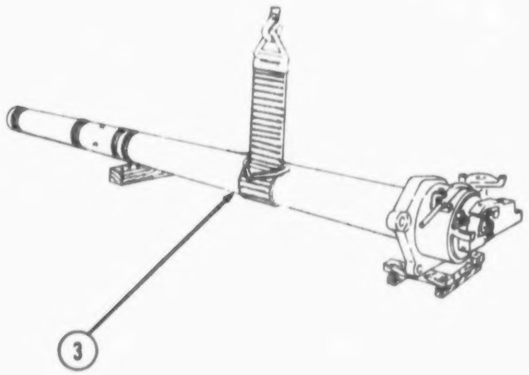

16
3
CENTER OF GRAVITY

MOUNT AND HOWITZER ASSEMBLY

4-2. CANNON ASSEMBLY (MOUNT OFF CAB)

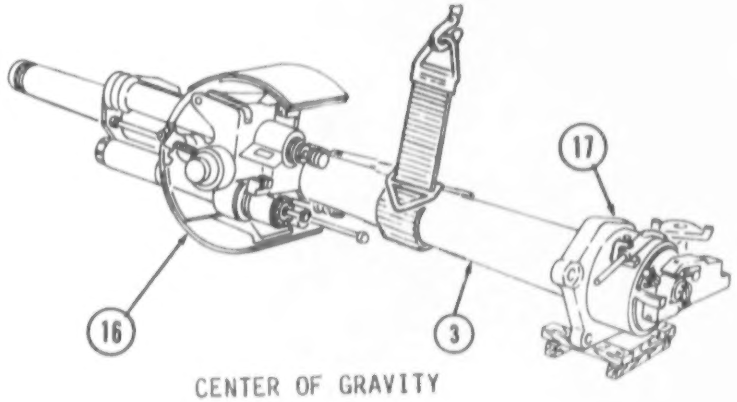
a. Disassembly-Continued





12 Raise cannon tube (3) slightly and slide rearward completely out of mount (16). Place cannon assembly (3) on blocks.

b. Assembly



CENTER OF GRAVITY

WARNING

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

1 Attach single sling (Item 6, App. B) to cannon assembly (3) at center of gravity.

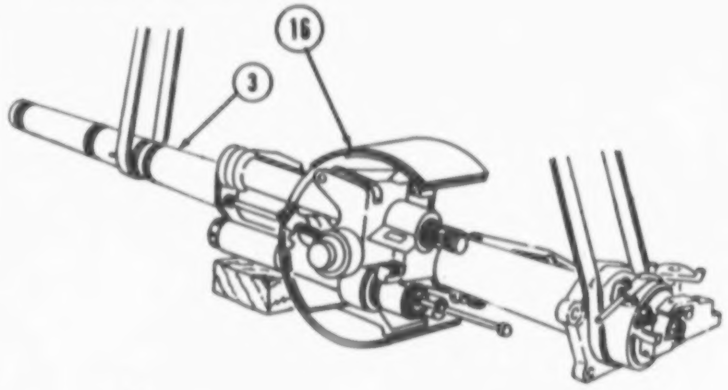
2 Raise cannon assembly (3) slightly and slide forward through mount (16) until breech ring band (17) is four feet (1219 mm) from mount (16).

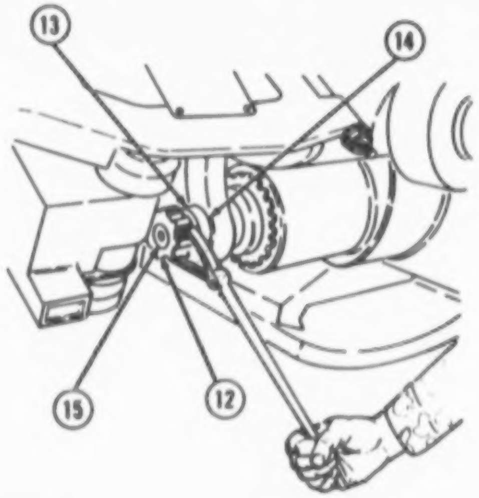
3 Lower hoist (not shown) to slacken single sling and remove single sling.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-2. CANNON ASSEMBLY (MOUNT OFF CAB) – Continued

b. Assembly-Continued

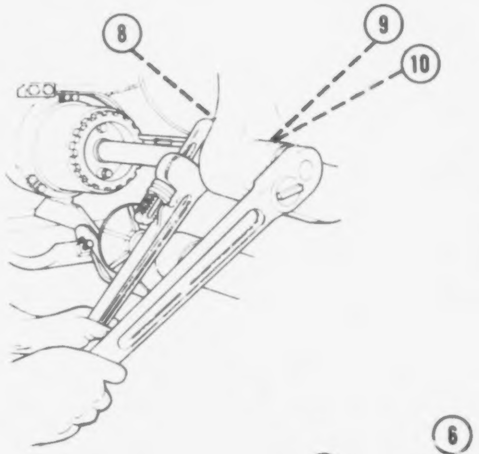


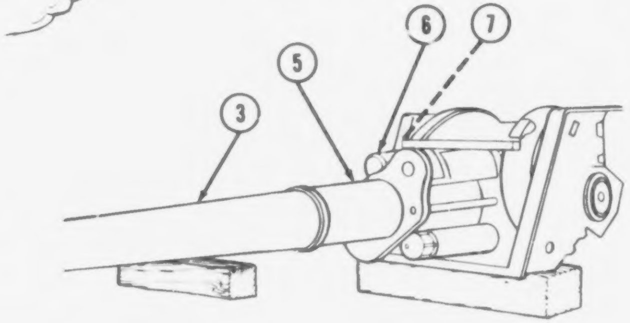


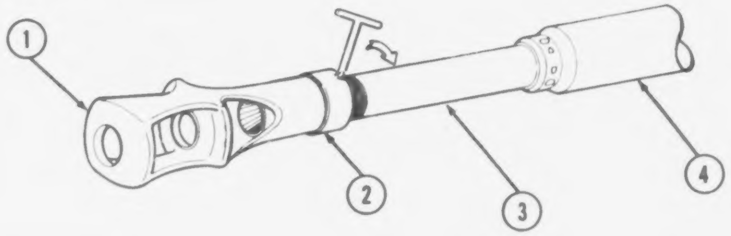
4 Attach two slings to cannon assembly (3) and to hoist not shown.

5 Raise hoist (not shown) to remove slack from two slings and lide cannon assembly (3) forward to position in mount (16).

6 Install two ring keys (14), two key washers (13) and two round nuts (12) on two variable recoil cylinder rods (15) using spanner wrench. Bend tabs of two key washers (13).







7 While holding collar (8) with pipe wrench, install slotted nut (10) and new cotter pin (9).

8 Install torque key (7) on base of cannon assembly (3) at mount (16).

9 Install dust shield (5) on variable recoil housing (6) (ref. page 4-94).

10 Install bore evacuator (4) on cannon assembly (3) (ref. page 4-77).

11 Install thrust collar (2) and muzzle brake (1) on cannon assembly (3) (ref. page 4-79).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-3. MUZZLE BRAKE AND THRUST COLLAR

This task covers: a. Removal b. Inspection c. Installation

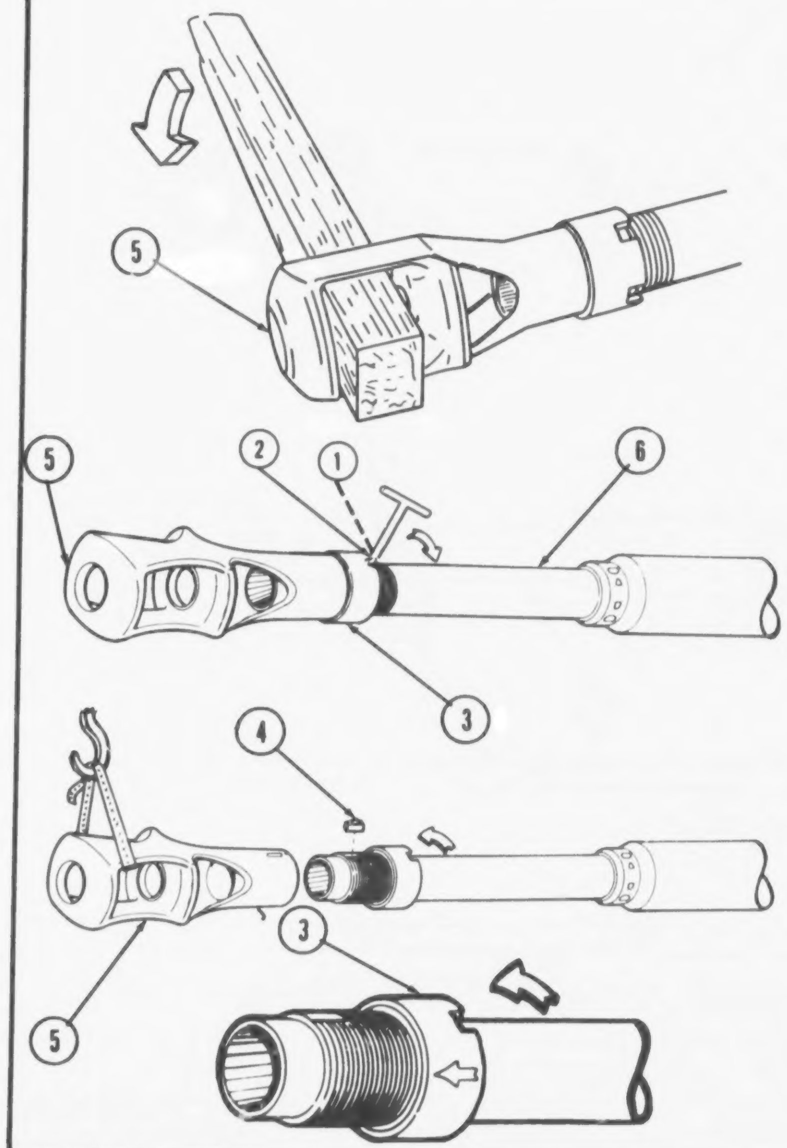
INITIAL SET-UP

Special Tools	Personnel Required
Rope or strap	2
Hoist	
Portable (truck) crane or maintenance stand	
4 x 4 inch or 2 x 4 inch timber approximately 5 ft. long	
Fabricated T-handle (App. E)	
Wrench, pipe, chain-type (Item 8, App. B)	

a. Removal

WARNING

- Wear gloves and steel-tipped safety shoes while performing the following task to prevent injury to personnel.
- Apply vehicle parking brake and place turret lock in LOCKED position to prevent accidental movement of the vehicle cab which can lead to serious injury.



1 Center and level cannon tube (6).

2 Remove setscrew (1).

3 Depress thrust collar detent (2) with fabricated T-handle (App. E) and screw thrust collar (3) rearward until key (4) is exposed. Remove key (4).

WARNING

Muzzle brake weighs approximately 350 pounds (159 kilograms). Use caution when removing to avoid serious injury.

NOTE

If necessary, use available 4 x 4 inch or 2 x 4 inch timber approximately 5 feet long to unscrew muzzle brake.

4 Unscrew (counterclockwise facing mount) muzzle brake (5) until threads in muzzle brake (5) just clear threads on cannon tube (6). Attach strap and hoist to muzzle brake (5) and remove.

5 Screw thrust collar (3) forward and remove.

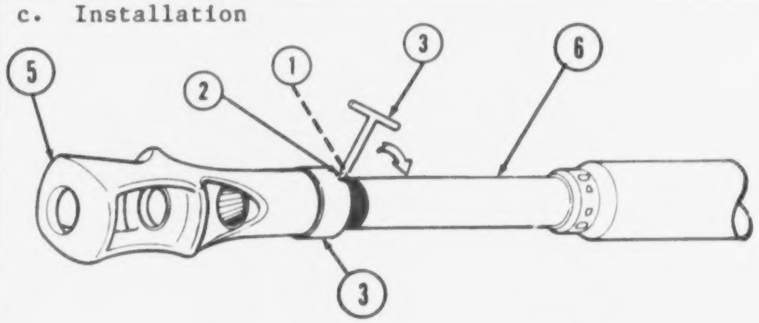
MOUNT AND HOWITZER ASSEMBLY — Continued

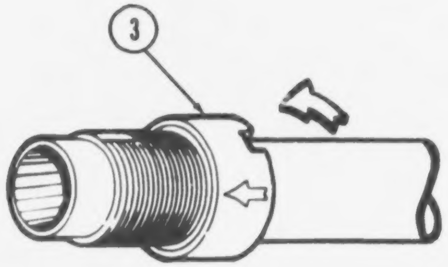
4-3. MUZZLE BRAKE AND THRUST COLLAR — Continued

b. Inspection

Inspect muzzle brake (6) for cracks. Replace if 1 inch (25.4 mm) or longer.

c. Installation



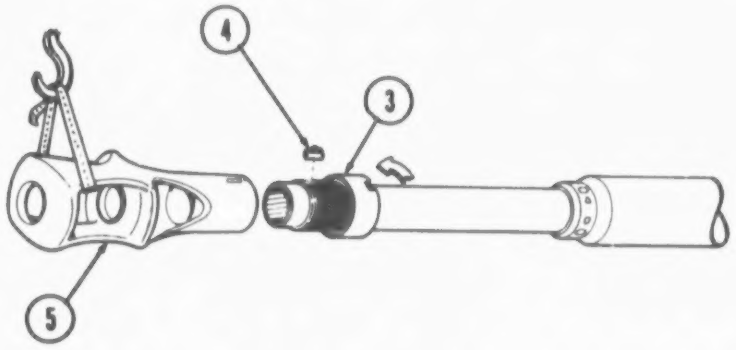


1 Screw thrust collar (3) onto cannon tube (6) just past keyway.

WARNING

Muzzle brake weighs approximately 350 pounds (159 kilograms). Use caution installing to avoid injury.

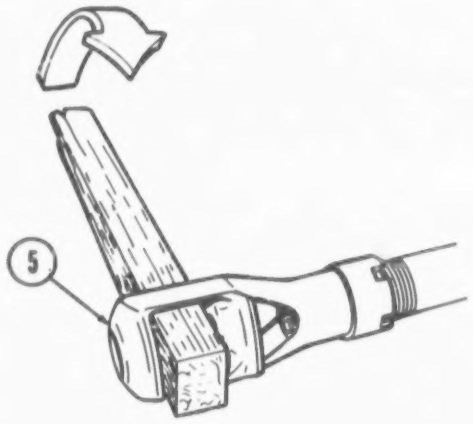
2 Use a hoist and strap to lift muzzle brake (5) into position on end of cannon tube (6) until threads meet.



NOTE

If necessary, use available 4 x 4 inch or 2 x 4 inch timber approximately 5 feet long to screw on muzzle brake.

3 Remove hoist and strap. Screw muzzle brake (5) (clockwise facing mount) into position.



NOTE

Muzzle brake is properly positioned when holes for bore sight strings are alined with face of muzzle end of cannon tube

4 Screw fabricated T-handle (App. E) into setscrew (1) hole and depress thrust collar detent (2).

5 Install key (4) and screw thrust collar (3) tight against muzzle brake (5) until thrust collar detent (2) is engaged.

6 Remove fabricated T-handle (App. E) and install setscrew (1).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-4. BORE EVACUATOR

This task covers: a. Removal b. Inspection and Repair c. Installation

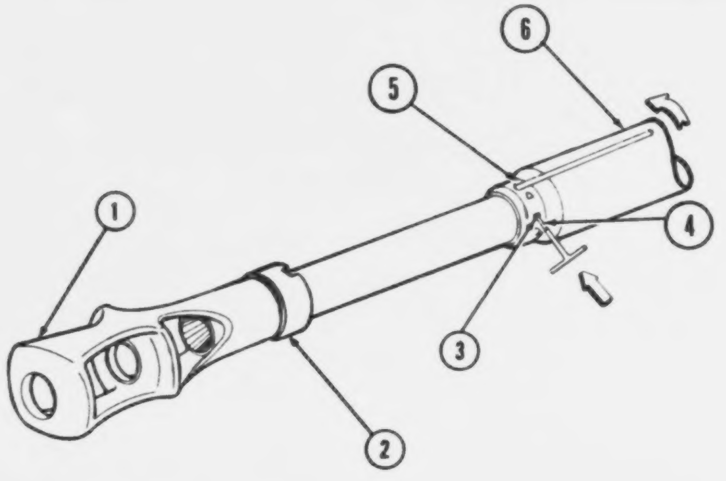
INITIAL SET-UP

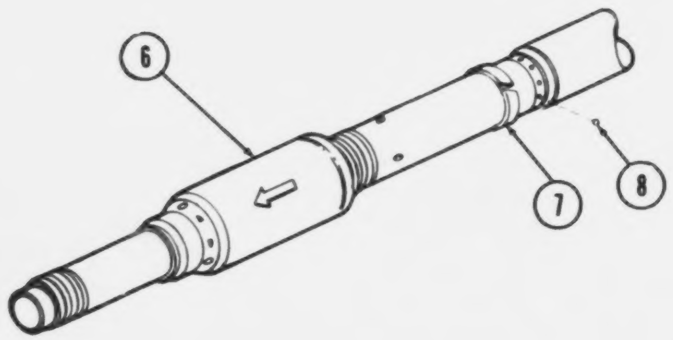
Special Tools	Personnel Required
Fabricated T-handle (App. E)	2

a. Removal

WARNING

- Wear gloves and steel-tipped safety shoes while performing the following task to prevent injury to personnel.
- Apply vehicle parking brake and place turret lock in LOCKED position to prevent accidental movement of the vehicle cab which can lead to serious injury.





1 Remove muzzle brake (1) and thrust collar (2) (ref. page 4-72).

2 Remove setscrew (3).

3 Screw fabricated T-handle (App. E) into setscrew (3) hole and depress detent (4).

4 Insert suitable rod into evacuator hole (5) and turn to unscrew bore evacuator (6)

5 Slide bore evacuator (6) forward to remove.

6 Slide valve ring (7) forward and catch ten balls (8) in a suitable container.

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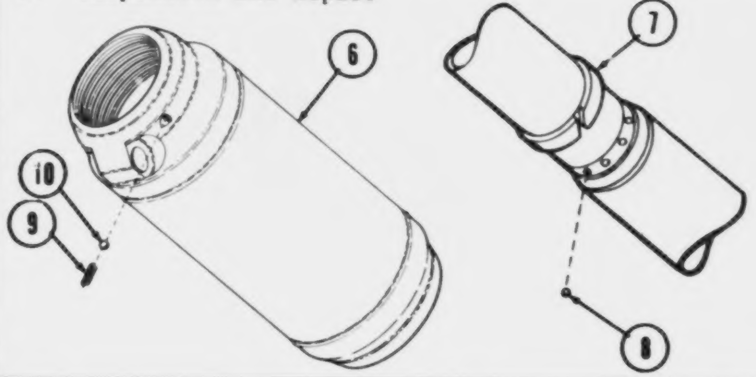
MOUNT AND HOWITZER ASSEMBLY — Continued

4-4. BORE EVACUATOR

b. Inspection and Repair



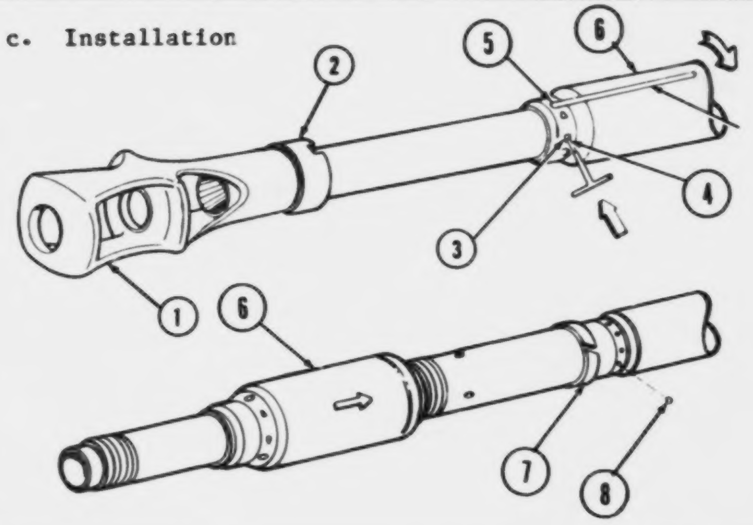
1 Inspect bore evacuator (6) for cracks, thread damage or distortion. Replace if damaged.

2 Inspect operation of spring (9) and ball (10). Repair as necessary.

3 Inspect valve ring (7) and ten balls (8) Replace if deformed. Use only authorized balls.

4 Clean and lubricate (ref. LO 9-2350-311-12).

c. Installation



1 Install ten balls (8) and valve ring (7).

2 Screw fabricated T-handle (App. E) into setscrew (3) hole and depress detent (4).

3 Slide bore evacuator (6) rearward and using suitable rod inserted in evacuator hole (5), screw bore evacuator (6) into place.

4 Remove fabricated T-handle (App. E) and install setscrew (3).

5 Install thrust collar (2) and muzzle brake (1) (ref. to page 4-74).

4-5. CANNON TUBE

This task covers: a. Removal b. Inspection c. Installation

INITIAL SET-UP	Special Tools	Personnel Required
Materials/Parts Lock wire Lock washers Nitrogen (Item 18 App. C)	Support blocks with wedges (to support cannon tube when removed) Wrench, pipe, chain-type (5120-00-866-5850) (Item 8, App. B) or 4 x 4 inch or 2 x 4 inch timber about 5 ft. long Hoist of 3200 lbs. (1453 Kg) lifting capacity Gun tube sling (Item 6, App. B) Fabricated eyebolt assembly and cable (App. E) Rope or cable, 30 ft., hook at each end Fabricated T-handle (App. E) Kit, Nitrogen filling (App E)	4

a. Removal

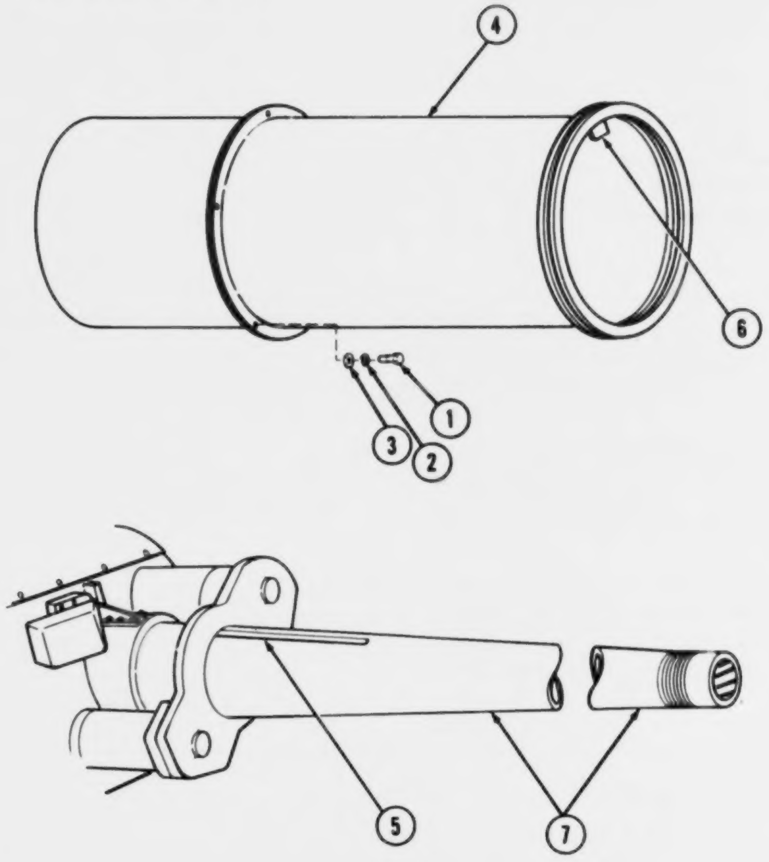
WARNING

- Wear gloves and steel-tipped safety shoes to avoid possible injury.
- Park vehicle on level ground with brake engaged to prevent injury due to vehicular movement.
- Make sure MASTER switch is OFF to prevent injury due to accidentally activating controls for cab or component movement.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE — Continued

a. Removal-Continued



1 Remove travel lock from gun tube (ref. TM 9-2350-311-10).

2 Position cannon at 0° traverse and 0° elevation (ref. TM 9-2350-311-10).

3 Drain oil from equilibration system manifold (ref. page 5-104).

4 Place traverse lock in LOCKED position (ref. TM 9-2350-311-10).

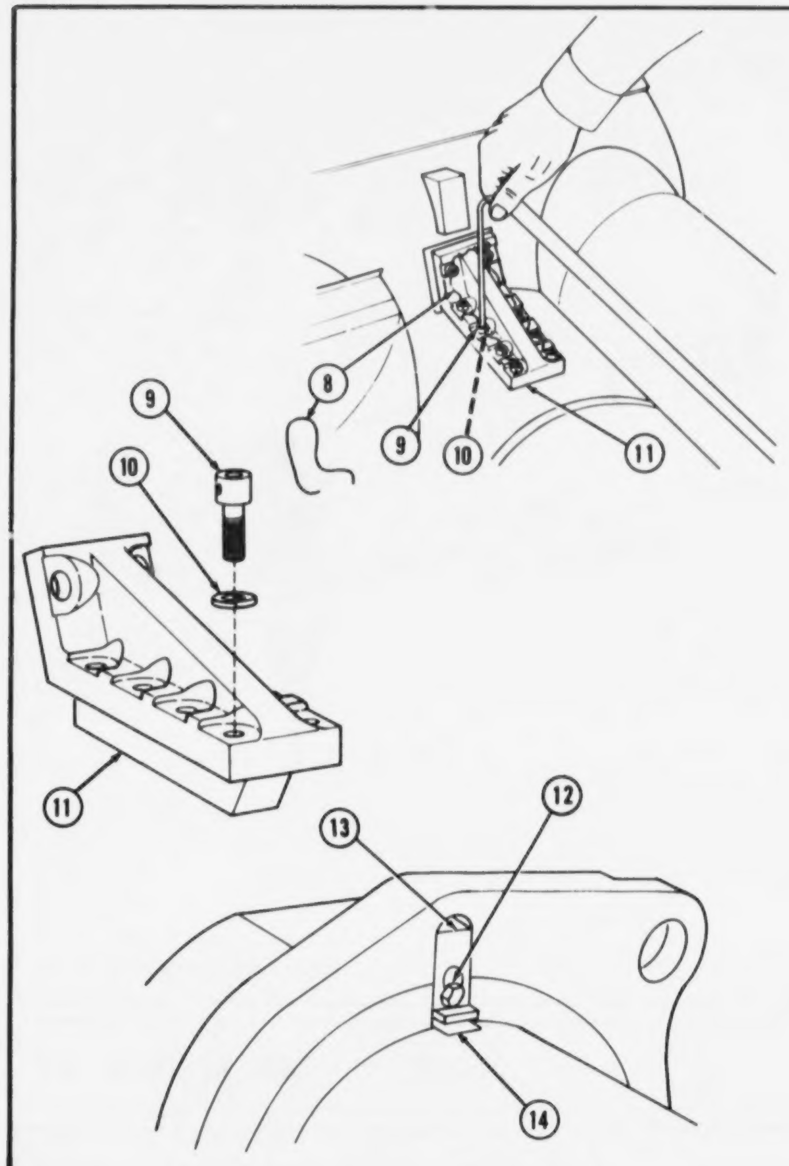
5 Remove muzzle brake (ref. page 4-73).

6 Remove bore evacuator (ref. page 4-76).

7 Remove four screws (1), four lock washers (2) and four flat washers (3) to loosen dust shield (4). Discard four lock washers (2).

8 Slide dust shield (4) forward along cannon keyway (5) until tab (6) is free of cannon keyway (5).

9 Remove dust shield (4) from cannon tube (7).



10 Remove lock wire (8), ten screws (9), ten lock washers (10) and torque key (11). Discard lock wire (8) and ten lock washers (10).

NOTE

Cannon may have to be pushed out of battery (ref. TM 9-2350-311-20-2) to gain access to cap screw.

11 Loosen cap screw (12).

12 Slide breech ring key (13) up and out of slot (14). Do not remove cap screw (12) or breech ring key (13).

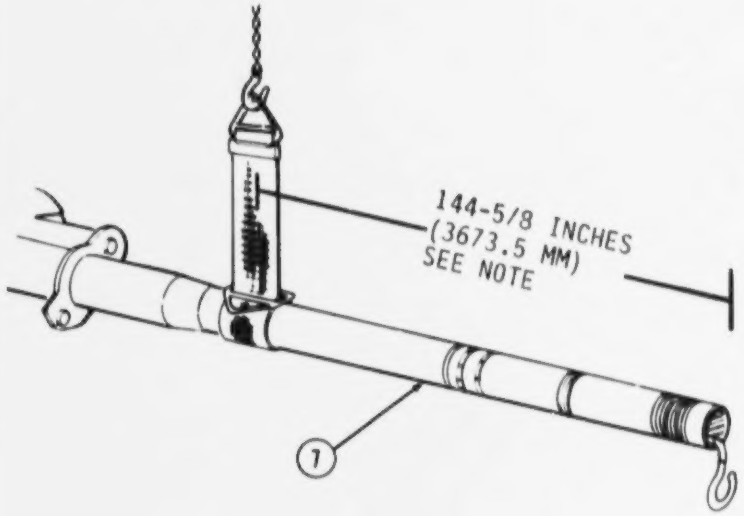
13 Tighten cap screw (12).

14 Open breechblock.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE — Continued

a. Removal-Continued



CAUTION

Tie a greased rag around hook to avoid damage to lands of cannon tube.

15 Thread one end of a 30 foot rope or cable (with hooks at each end) through cannon tube (7) until hook comes out muzzle end.

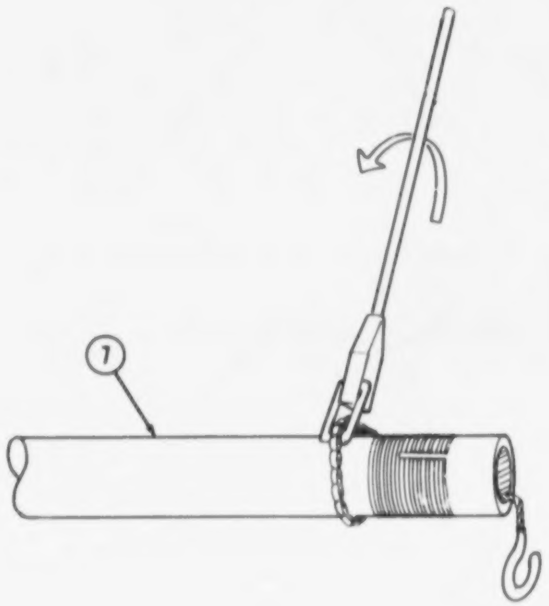
WARNING

Use hoist of at least 3200 pounds (1453 kilograms) to prevent injury to personnel.

16 Attach gun tube sling (Item 6, App. B) in choke hitch at point of cannon tube (7) indicated as center of balance (center of balance is 144-5/8 inches (3673.5 mm) from face of muzzle.

NOTE

Center of balance is 148 inches (3759.2 mm) from face of muzzle brake with bore evacuator and muzzle brake installed.



17 Sustain weight of cannon tube (7) with hoist but do not lift cannon tube (7). Place breech stand (not shown) between the breech ring (not shown) and the floor of the vehicle, as required, to support the breech ring (not shown) after withdrawal of cannon tube (7).

NOTE

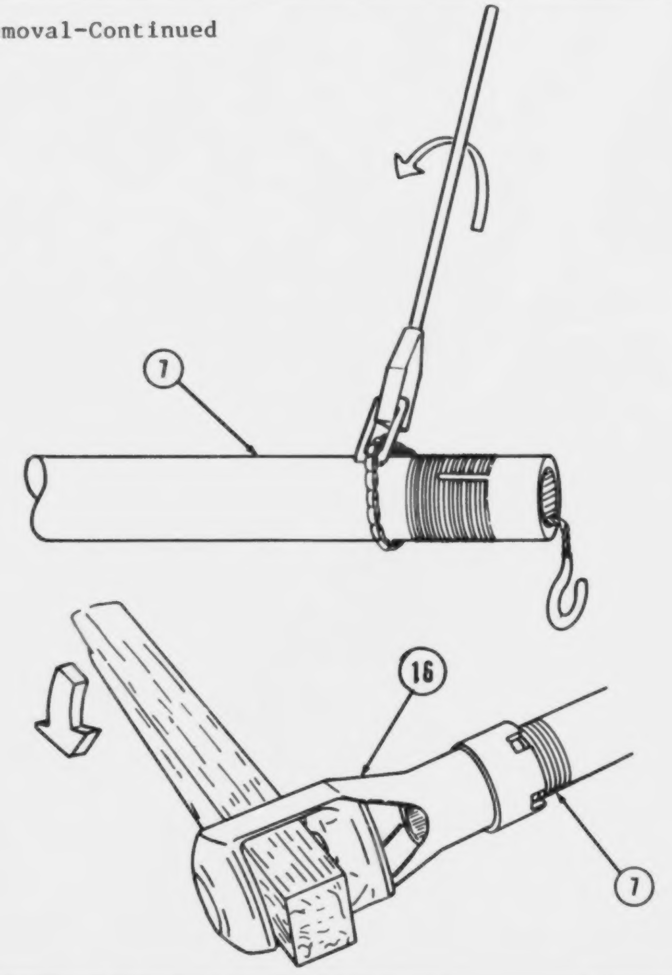
Refer to steps 20 and 21 for alternate method of rotating cannon tube if chain-type pipe wrench (Item 8, App. B) is NOT available and muzzle brake has NOT been removed.

18 Install chain-type pipe wrench (Item 8, App.B) on cannon tube (7) at a location without critical external features.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE – Continued

a. Removal-Continued



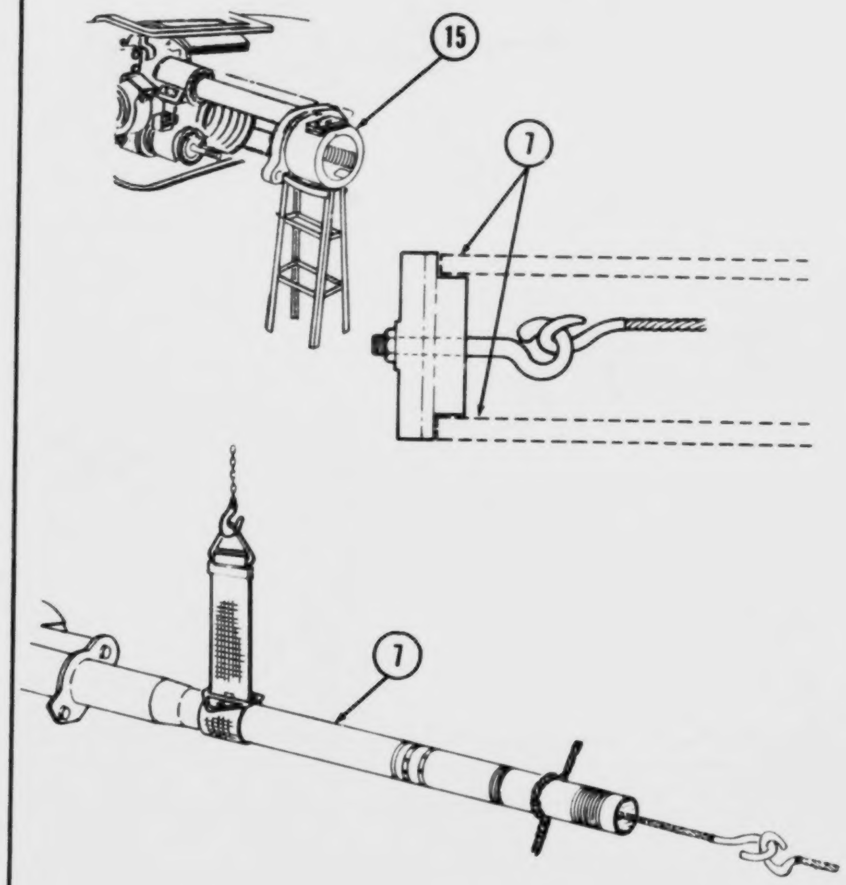
NOTE

- Cannon tube is rotated 45° when keyway on cannon tube is alined with uppe- left bolt hole for dust shield.
- If tube is difficult to rotate, some of the nitrogen pressure in the recuperator may have to be drained to relieve binding on breech ring band

19 Rotate cannon tube (7) 45° counterclockwise to disengage cannon tube (7) from breech ring (15) threads.

20 If chain-type pipe wrench (Item 8, App. B) is not available, insert a 4 x 4 inch or 2 x 4 inch wooden timber of at least 5 feet in length into muzzle brake (16).

21 Using wooden timber for leverage, rotate muzzle brake (16) and cannon tube (7) 45° counterclockwise to disengage cannon tube (7) from breech ring threads.



WARNING

Breech ring must be supported prior to removal of cannon tube to prevent injury to personnel.

22 Support breech ring (15) with breech stand before beginning removal of cannon tube (7).

23 Connect rear fabricated eyebolt assembly (App. E) to rope or cable (with hooks at each end) in breech ring (15) and center at rear face of cannon tube (7) as rope or cable is pulled tight from other end.

24 Attach other end horizontally to hoist and a fixed point, or to a vehicle. Keep rope or cable tight.

25 Attach guide ropes to muzzle end of cannon tube (7).

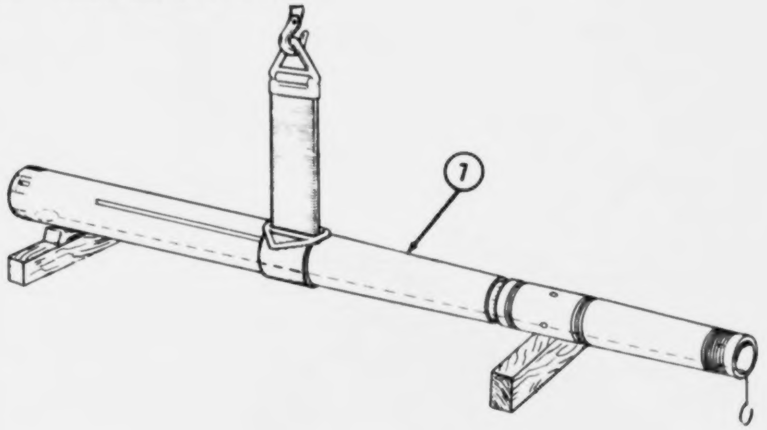
NOTE

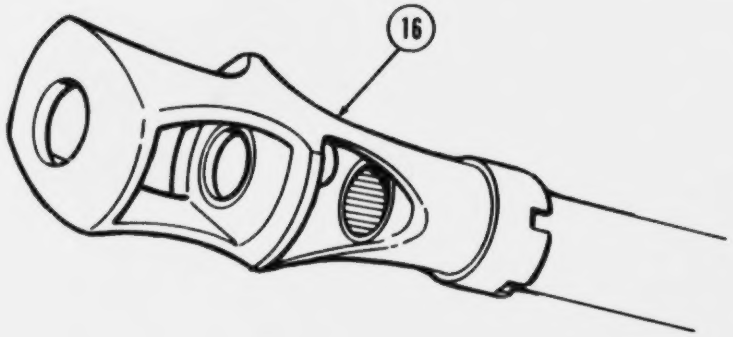
Use guide ropes to help balance and prevent swinging of tube during removal.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE — Continued

a. Removal-Continued





CAUTION

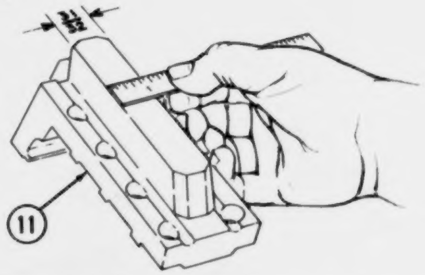
As cannon is withdrawn horizontally, the hoist sustaining the weight of the cannon should follow this movement to maintain the gun tube sling vertical and tight. Use care and withdraw slowly to prevent damage.

26 Withdraw cannon tube (7) from mount. Place on blocks or other stable support with wedges at breech end to prevent any rolling. Place blocks on level hardened surface, such as concrete, or equivalent.

27 Remove rear fabricated eyebolt assembly (App. E) (ref. page 4-85) and hooks along with greased rag.

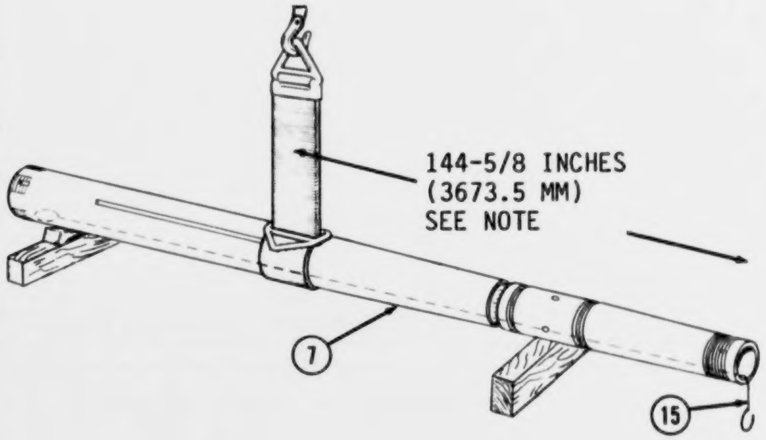
28 Remove muzzle brake (16), bore evacuator and dust shield, if installed (ref. pages 4-72, 4-76 and 4-94).

b. Inspection



To inspect torque key (11), measure width of torque key (11) on bottom surface in at least three places. Replace torque key (11) if width is less than 31/32 inches (0.968 inches, 24.60 mm) at any point along bottom of taper (ref. TM 9-2350-311-20-2).

c. Installation



1 Wrap one hook of 30 ft. rope or cable with greased rag and thread rope or cable into muzzle end of cannon tube (7). Hook wrapped in greased rag is in chamber end of cannon tube (7). Allow other end of rope to dangle out of muzzle end.

2 Attach gun tube sling (Item 6, App. B) in choke hitch at point in cannon tube (7) indicated as center of balance (144-5/8 inches, 3673.5 mm from face of muzzle).

NOTE

Center of balance is 148 inches (3759.2 mm) from face of muzzle brake with bore evacuator and muzzle brake installed.

WARNING

Use hoist of at least 3200 pounds (1560 kilograms) lifting capacity to prevent injury to personnel.

3 Attach gun tube sling (Item 6, App. B) to hoist (item 2, App. B).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE — Continued

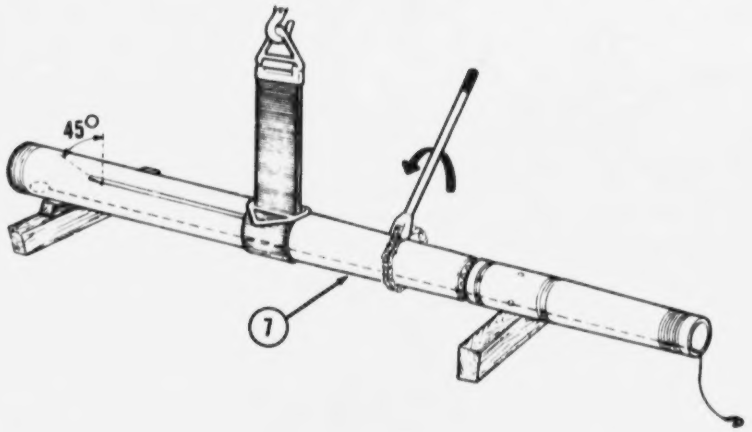
c. Installation-Continued

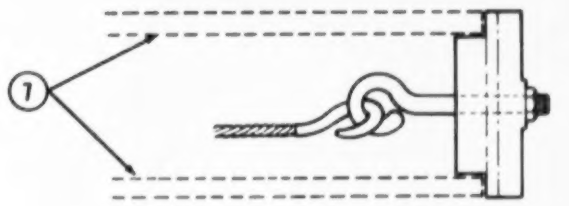
NOTE

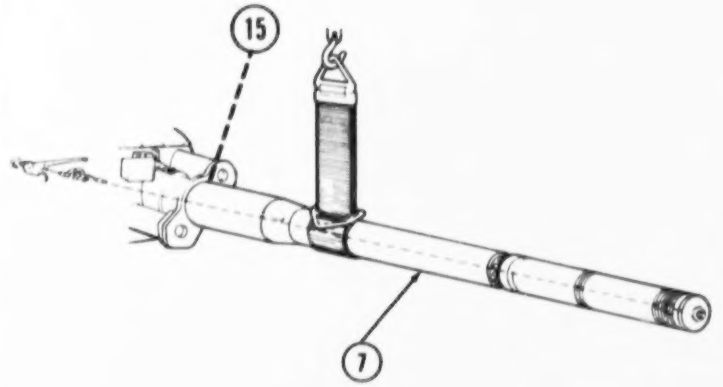
Mount in vehicle should be horizontal. Breech ring key should be up and secured out of the way.

4 Rotate cannon tube (7), if necessary, to cant torque key groove 45° counterclockwise from normal position for installation.

5 Loosen gun tube sling (Item 6, App. B). Move one wedge away from cannon tube (7) making it free to rotate. Using chain-type pipe wrench (Item 8, App. B), rotate cannon tube (7) 45°. Slide wedge back into place to hold cannon tube (7) in position.







NOTE

Before installation, clean and lube mount cradle bearings and cannon tube outer surface per LO 9-2350-311-12.

6 Lift cannon tube (7) horizontally and insert breech end into mount. Push cannon tube (7) carefully into mount, and attach front fabricated eyebolt assembly (App. E) to front hook at muzzle.

NOTE

If nitrogen has not been released from recuperator, the breech ring band may be out of line and will prevent tube installation.

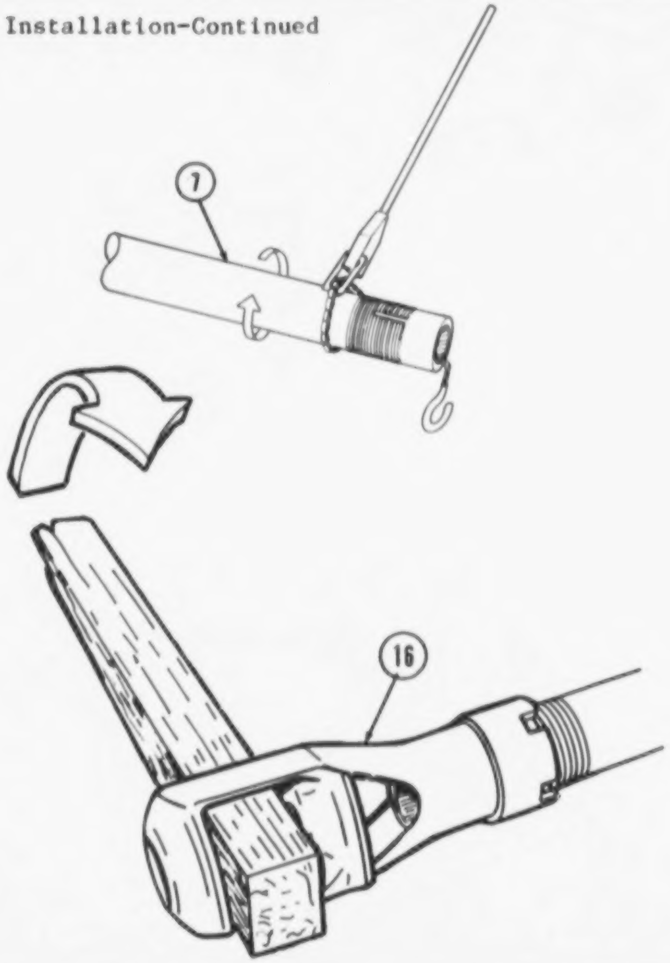
7 Draw rope or cable tight from within cab. Pull cannon tube (7) into mount until breech end is flush with front face of breech ring (15).

8 Attach come-along to rear hook of cable or rope if necessary to seat cannon tube (7) in breech ring (15).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE — Continued

c. Installation-Continued



NOTE

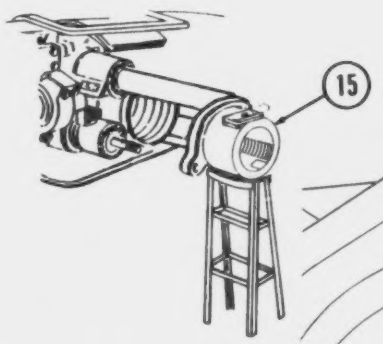
There is an alternate method for rotating cannon tube for installation if pipe wrench is not available and muzzle brake has not been removed. To use alternate method, perform procedural steps 11 and 12 instead of 9 and 10.

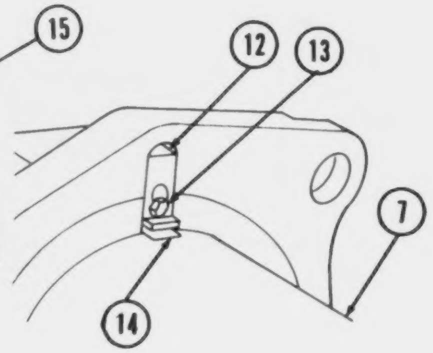
9 Place chain-type pipe wrench (Item 8, App. B) on cannon tube (7) at a location without critical external features.

10 Rotate cannon tube (7) 45° clockwise to engage cannon tube (7) and breech ring (15) threads.

11 Insert available 4 x 4 inch or 2 x 4 inch wooden timber approximately 5 feet long into muzzle brake (16).

12 Using wooden timber for leverage, rotate muzzle brake (16) and cannon tube (7) 45° clockwise to engage cannon tube (7) and breech ring (15) threads.



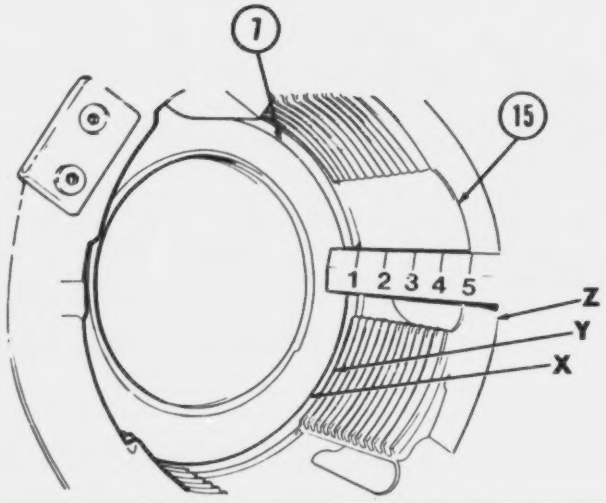


13 To install breech ring key (13), loosen cap screw (12). Slide breech ring key (13) downward into slot (14) and tighten cap screw (12).

14 If nitrogen pressure has been depleted, reestablish pressure in recuperator. Remove hoist, gun tube sling and chain-type pipe wrench from cannon tube (7) or 4x4 inch timber (ref. pages 4-87 and 4-88). Remove breech stand 4x4 inch from under breech ring (15).

WARNING

Cannon will not be fired until cannon tube and breech ring are properly assembled, alined and adjusted.



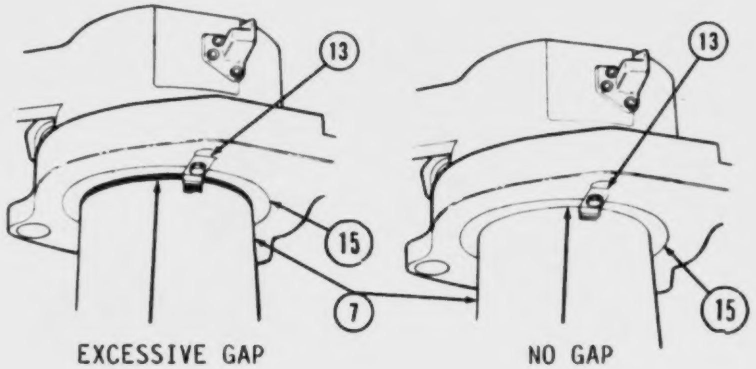
15 To insure proper fit of cannon tube (7) and breech ring (15), inspect inner breech ring (15) surfaces.

Rear face of gun tube (X) must be flush with front face of breech ring (Y). Distance from rear face of cannon tube to rear face of breech ring (Z) must be no more than five inches (127 mm).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-5. CANNON TUBE — Continued

c. Installation-Continued



EXCESSIVE GAP

NO GAP

IMPROPER FIT

CORRECT FIT

16 Inspect position of breech ring key (13).

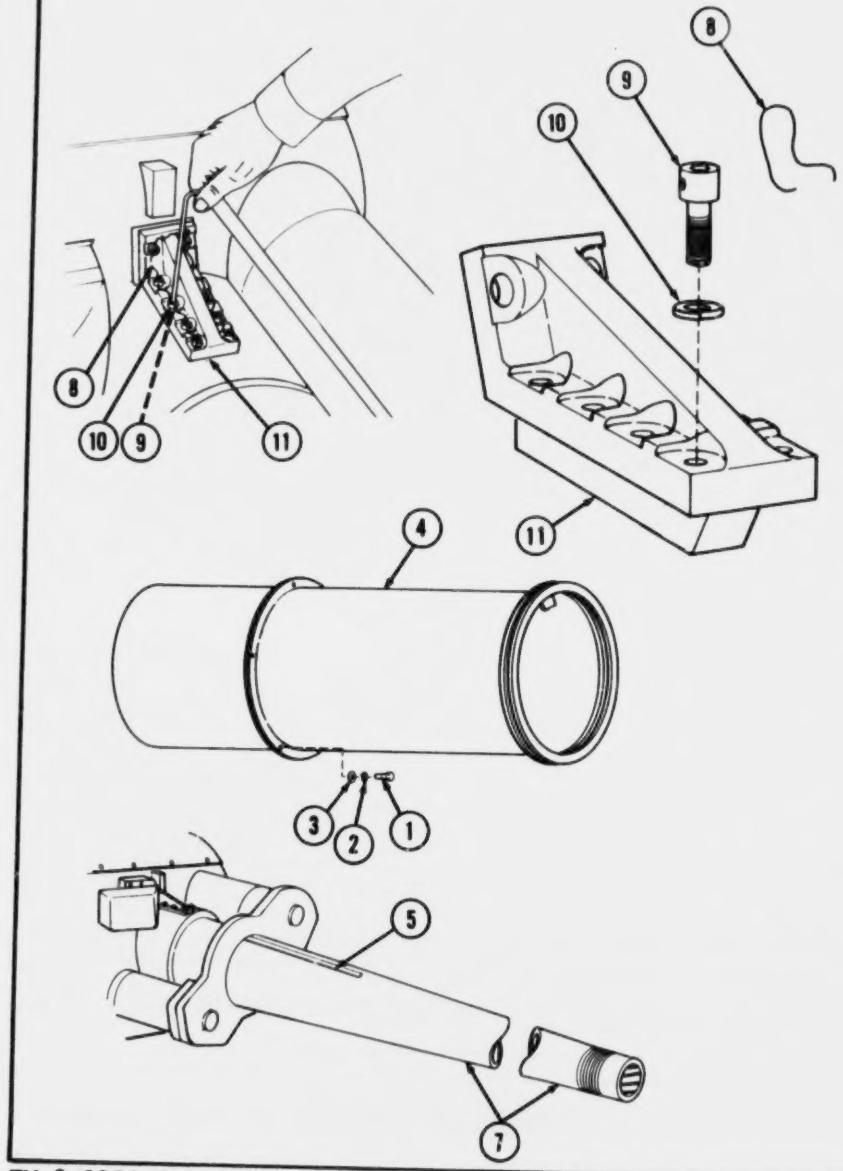
NOTE

Rectangular key should fill all but the rounded end of the slot. This is difficult to see with cannon installed in mount; feel with little finger to make sure.

17 Inspect cannon tube (7) at front face of breech ring (15).

NOTE

Machined end of gun tube should not show if tube is properly installed in breech ring. There should be no gap between front face of breech ring and the facing tube.



18 Install torque key (11) with ten new lock washers (10), ten screws (9), and new lock wire (8), using hex head key.

19 Install dust shield (4), sliding backward onto cannon tube (7) and cannon keyway (5).

20 Install four flat washers (3), four new lock washers (2) and four screws (1) to hold dust shield (4) securely in position.

NOTE

- After replacement of cannon tube all fire control components must be checked for bore alinement, refer to TM 9-2350-311-20-2.
- After cannon tube replacement, adjustment of breech cam roller clearance must be checked and adjusted refer to TM 9-2350-311-20-2.

MOUNT AND HOWITZER ASSEMBLY

4-6. DUST SHIELD ASSEMBLY

c. Assembly

INITIAL SET-UP

Materials/Parts
Seal
Gasket

a. Disassembly

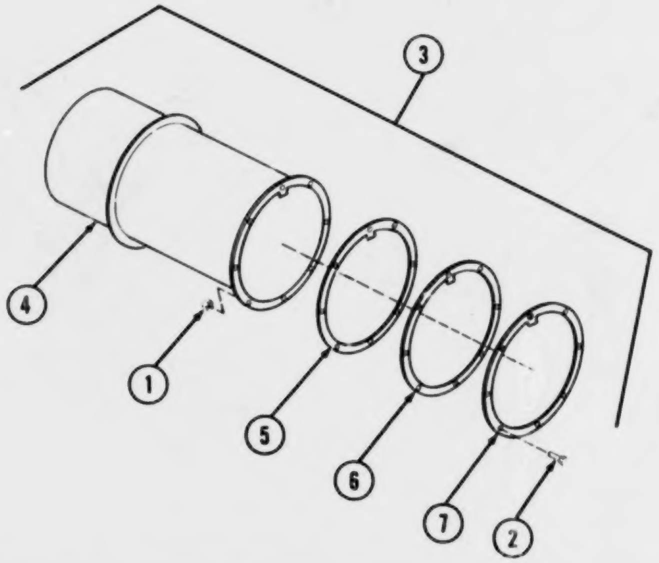
WARNING

Wear gloves and steel-tipped safety shoes to prevent injury to personnel.

NOTE

Prior to disassembly, the following must be performed:

- Removal of muzzle brake and evacuator (ref. pages 4-72 and 4-76).
- Removal of dust shield from mount and cannon (ref. page 4-80).



1 Remove eight nuts (1) and eight screws (2) from dust shield assembly (3).

2 Separate dust shield (4), seal (5), gasket (6) and retainer (7). Discard seal (5) and gasket (6).

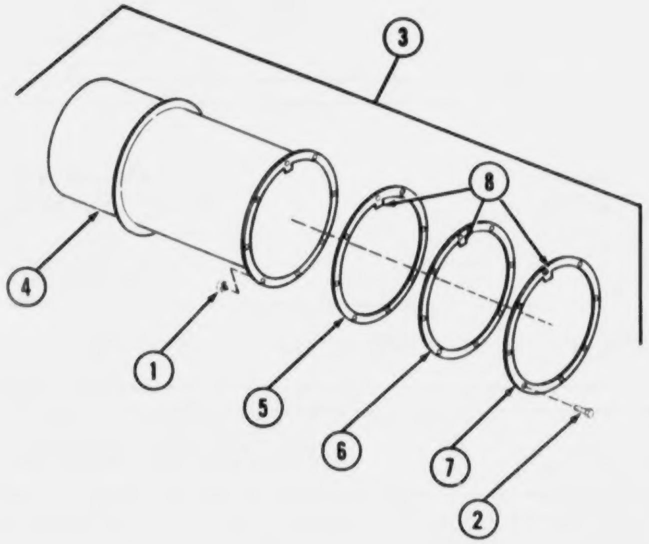
b. Inspection and Repair

1 Inspect dust shield (4) for distortion. Repair or replace if damaged or distorted.

2 Install new seal (5) and new gasket (6).

3 Inspect retainer (7). Install new retainer (7) if distorted or if tab (8) is worn.

c. Assembly



1 Assemble retainer (7), new gasket (6), new seal (5) and dust shield (4) (insuring that new seal (5), new gasket (6) and retainer (7) have tabs (8) alined to fit into keyway at top of cannon tube).

2 Install eight screws (2) and eight nuts (1) into dust shield assembly (3).

MOUNT AND HOWITZER ASSEMBLY — Continued

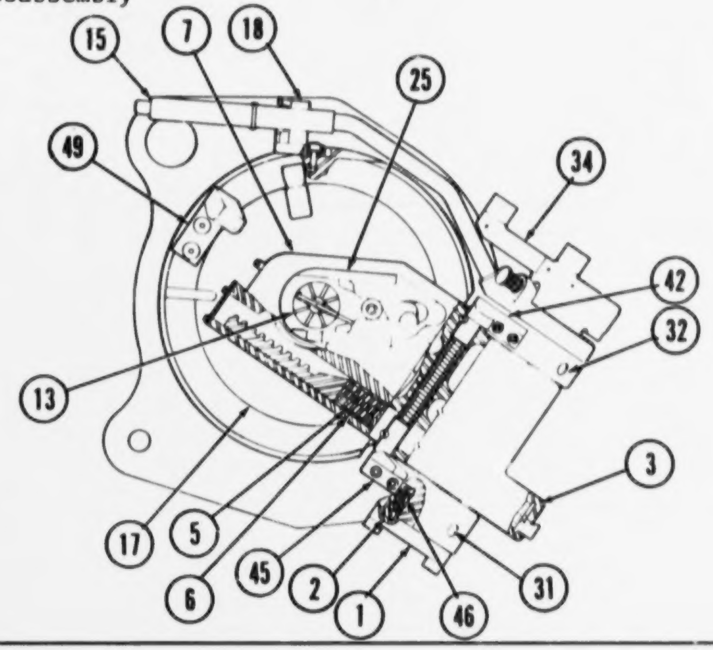
4-7. BREECH MECHANISM

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

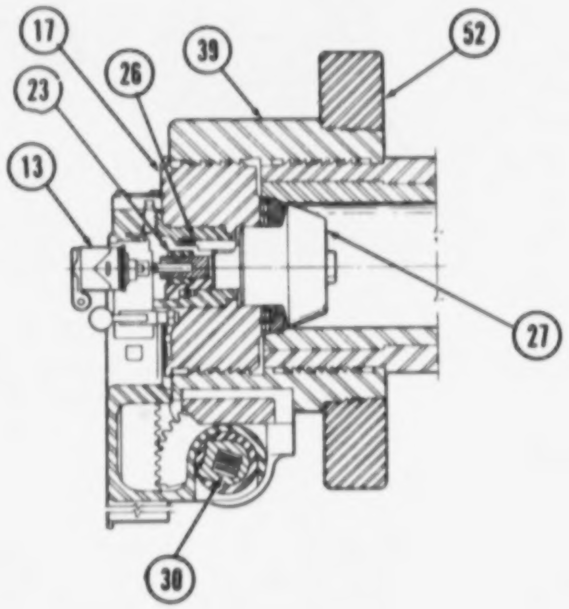
Materials/Parts	Special Tools	Personnel Required
Lock washers	Spanner wrench 8769014 Spanner wrench MS16246-3	3

a. Disassembly



Legend

1. Breechblock adjuster
2. Closing mechanism
3. Rack plate
5. Rack spring
6. Rack spring
7. Carrier assembly
13. Firing mechanism
15. Breech operating handle
17. Breechblock
18. Operating handle stop
25. Firing mechanism housing group
31. Adjuster detent
32. Breech ring upper lug detent (operating crank detent)
34. Operating crank assembly
42. Right catch (upper)
45. Left catch (lower)
46. Spring
49. Cam



Legend

13. Firing mechanism
17. Breechblock
23. Obturator spindle nut
26. Obturator spindle spring
27. Obturator spindle assembly
30. Leaf spring
39. Breech ring body
52. Breech ring band

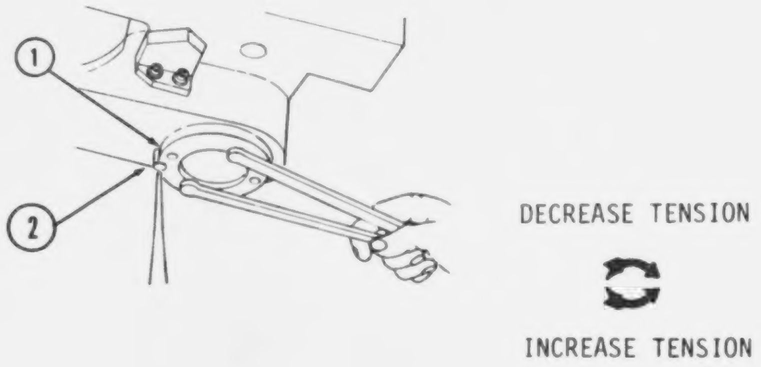
WARNING

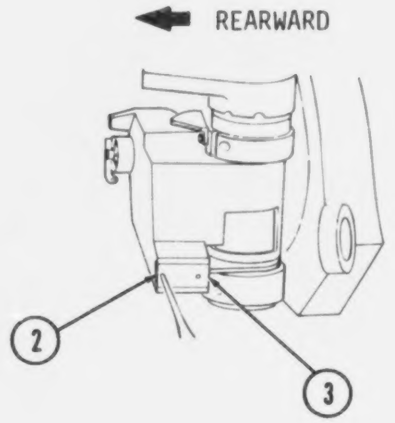
- Wear steel-tipped safety shoes, safety glasses and gloves to avoid possible injury.
- Make sure breechblock is in closed position.
- Springs of breechblock are under 130 lb-ft (176 N·m) load pressure. Use extreme care when removing components of the breech mechanism to avoid possible injury.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

a. Disassembly-Continued





NOTE

The direct fire telescope must be removed prior to disassembly of the breech mechanism (ref. TM 9-2350-311-20-2).

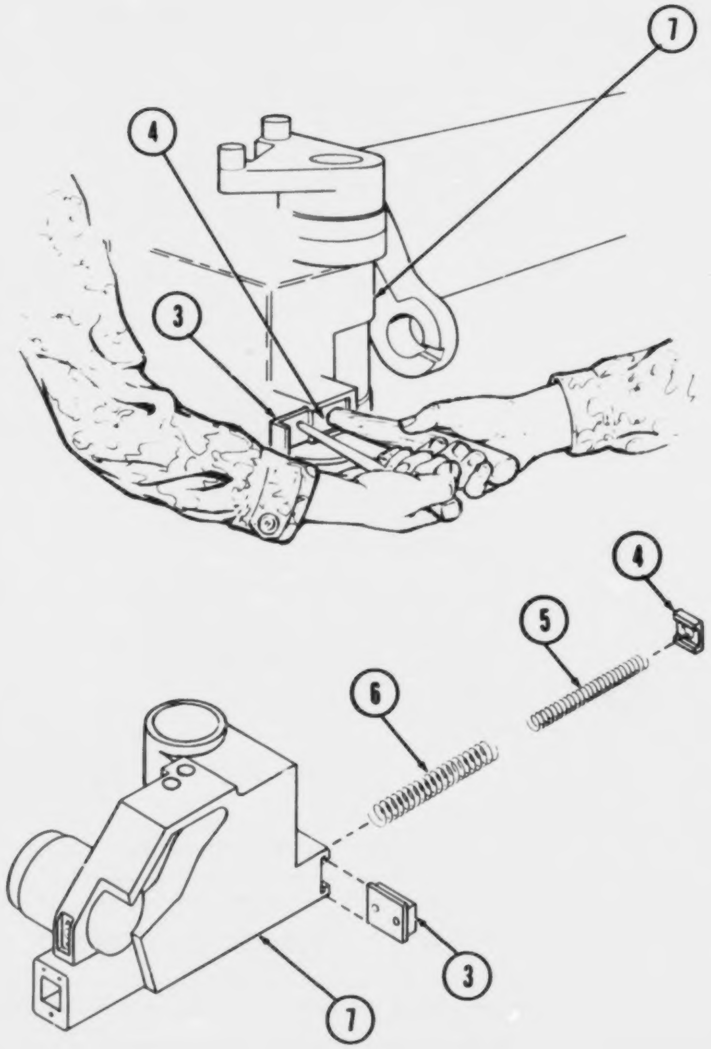
1 Check closing of breech with breechblock adjuster (1) set in the first notch.

NOTE

Some adjusters have lugs; use an adjustable wrench on these lugs.

2 To release preload on breech mechanism closing spring, engage a spanner wrench in holes of breechblock adjuster (1). Depress closing mechanism adjusting plunger (2) with a punch and rotate breechblock adjuster (1) slowly in a clockwise direction until all torque has been relieved.

3 With breechblock still closed, depress closing mechanism adjusting plunger (2) with a punch and slide rack plate (3) rearward until rack plate (3) disengages from plunger (2), but do not remove rack plate (3) yet.



WARNING

UNDER NO CIRCUMSTANCES will the removal of springs be attempted with breechblock open. Springs are under heavy pressure and can cause severe injury if removed improperly.

4 With breechblock still closed, apply pressure with a wood hammer handle or suitable-sized wooden dowel to stop plate (4) to restrain rack springs (5 and 6). Slide out rack plate (3) using punch.

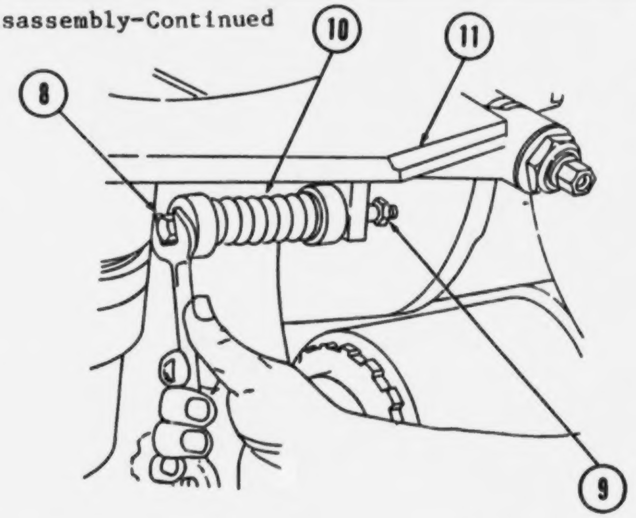
5 Release the pressure applied to the wooden dowel or wood hammer handle slowly allowing both rack springs (5 and 6) to expand.

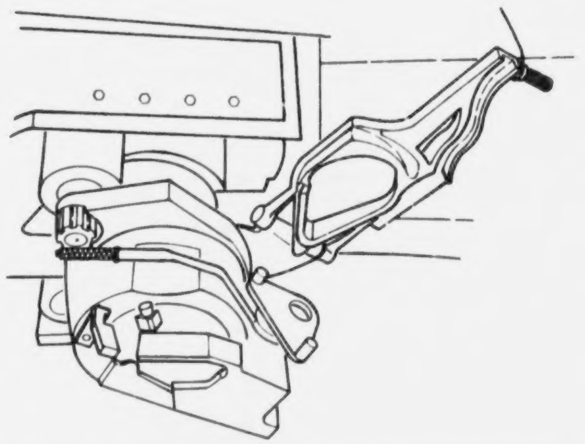
6 Remove stop plate (4) and rack springs (5 and 6) from carrier assembly (7). Install rack plate (3) back into the carrier assembly (7).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

a. Disassembly-Continued



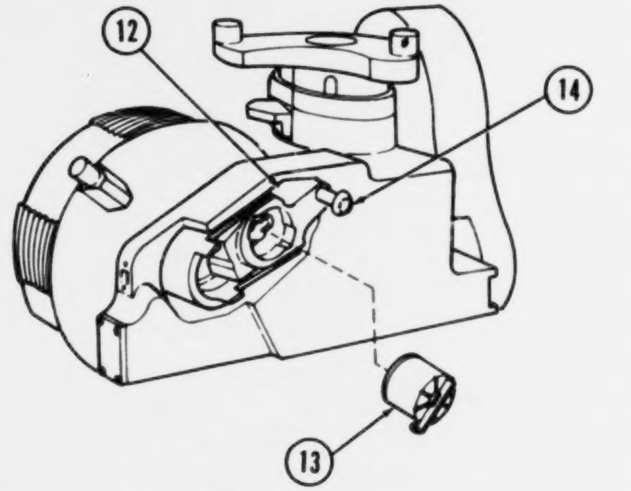


7 Remove hex head bolt (8), jam nut (9) and remaining parts of damper assembly (10).

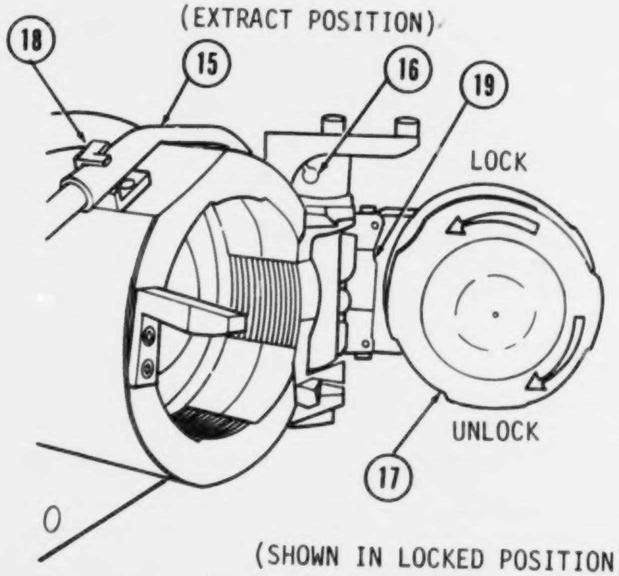
NOTE

For disassembly of damper assembly, refer to page 4-135.

8 Raise breech mechanism operating cam (11) and secure it to the cab roof with a rope.



(EXTRACT POSITION)



(SHOWN IN LOCKED POSITION)

9 Move firing group block (12) to center position. Push firing mechanism (13) into firing group block (12) and rotate 70° clockwise to remove.

10 Move firing group block (12) to extreme right position by pulling knob (14) out and sliding firing group block (12) to right.

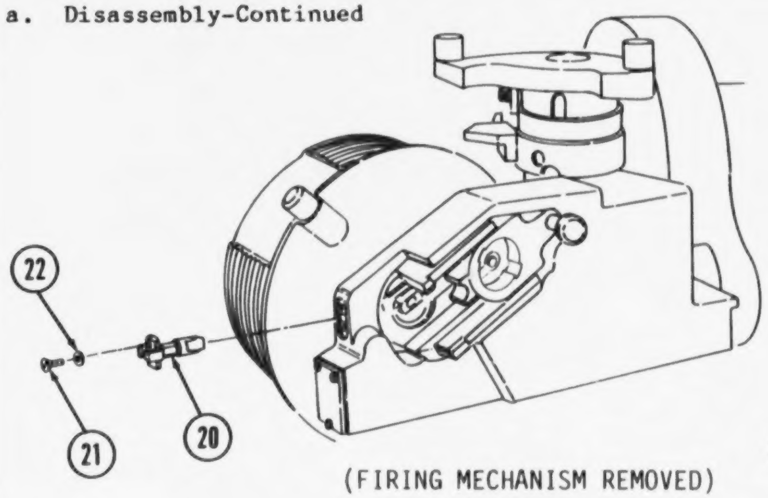
11 With one man supporting the breech mechanism, use the breech operating handle (15) to engage the clutch pin (16) and to open the breechblock (17). Return operating handle (15) to operating handle stop (18).

12 Depress carrier detent plunger (19) using drive punch and rotate breechblock (17) to the LOCKED position.

MOUNT AND HOWITZER ASSEMBLY

4-7. BREECH MECHANISM – Continued

a. Disassembly-Continued

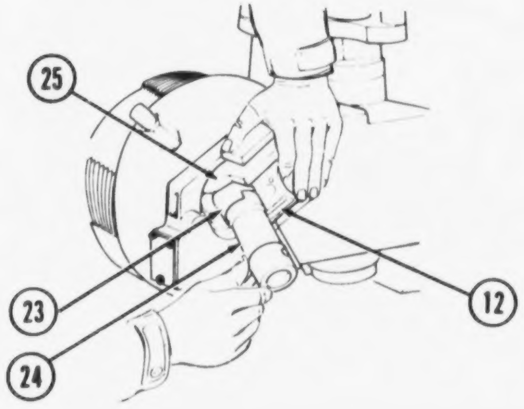


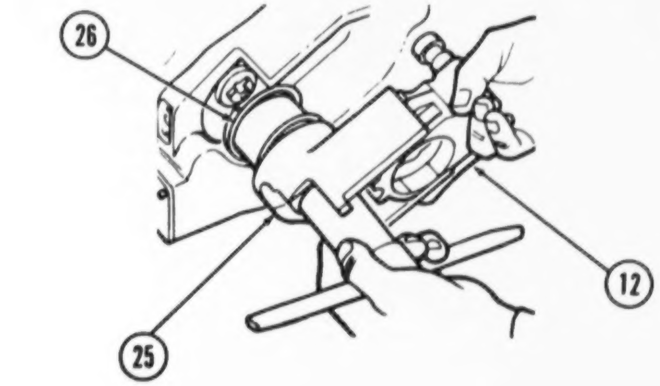
(FIRING MECHANISM REMOVED)

13 Remove plunger assembly (20) by removing two screws (21) and two lock washers (22). Discard two lock washers (22).

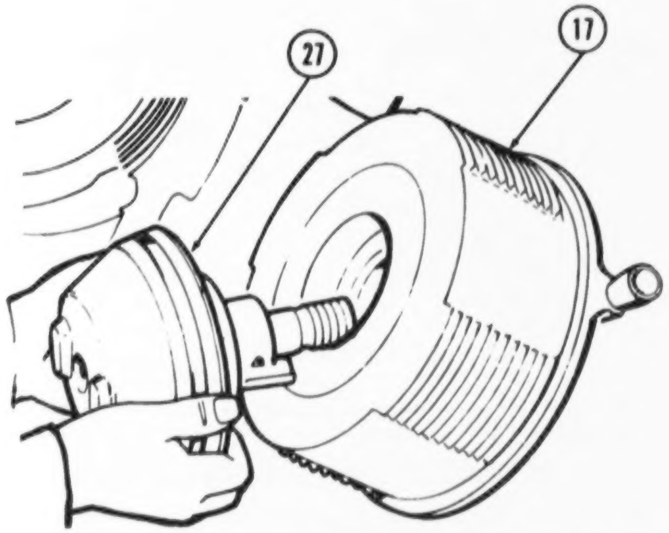
14 To remove obturator spindle nut (23), move extractor (24) away from obturator spindle nut (23).

15 Support firing group block (12) and firing mechanism housing (25) while using spanner wrench to remove obturator spindle nut (23) (ref. page 4-97).





16 Remove firing group block (12), firing mechanism housing group (25) and obturator spindle spring (26).

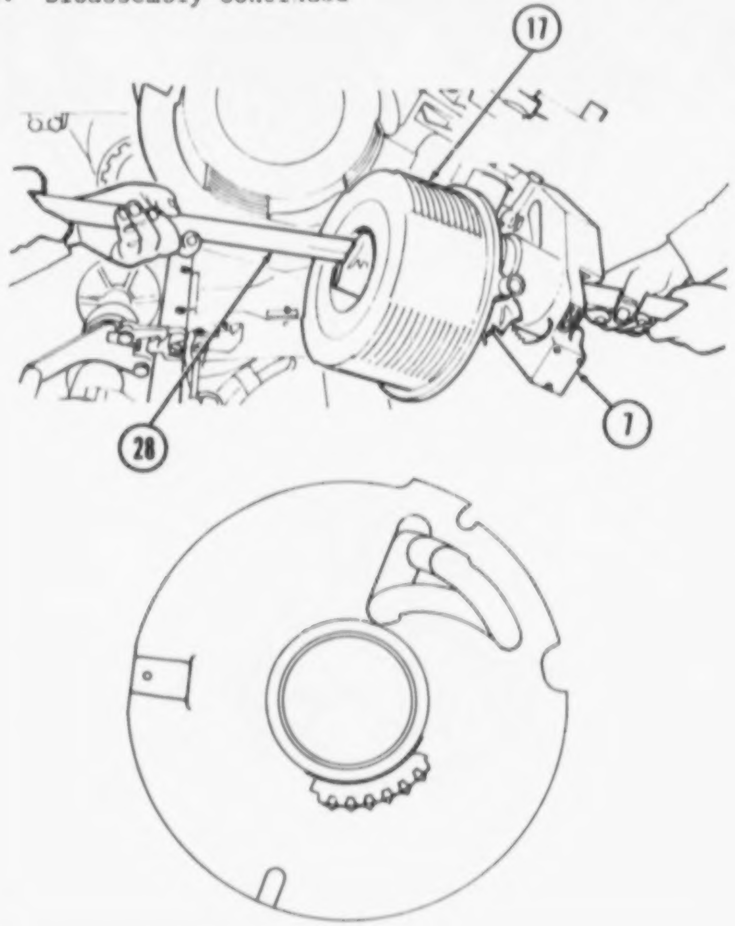


17 Remove obturator spindle assembly (27) from breechblock (17).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM – Continued

a. Disassembly-Continued



WARNING

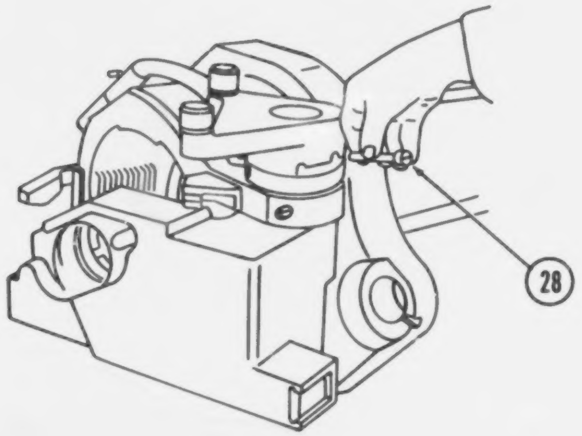
Breechblock weighs approximately 125 pounds (57 kilograms). Two persons are needed to remove the breechblock in order to prevent injury to personnel. Insert cleaning staff wrapped with rags through breechblock and carrier to prevent breechblock from sliding and injuring personnel.

18 To remove breechblock (17), position cleaning staff (28) wrapped with rags through spindle hole of breechblock (17).

19 While supporting both ends of cleaning staff (28), lift and slide breechblock (17) off carrier assembly (7).

NOTE

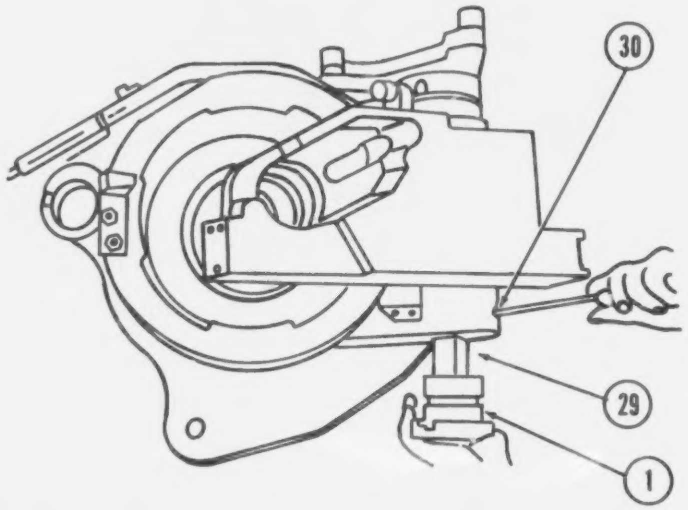
For disassembly of breechblock assembly, refer to page 4-120.



20 Unscrew and remove leaf spring torsion pin (28).

NOTE

- If rammer is not removed, push cannon out of battery to remove leaf springs (ref. TM 9-2350-311-20-2).
- Leaf spring torsion pin engages top hole of leaf spring.

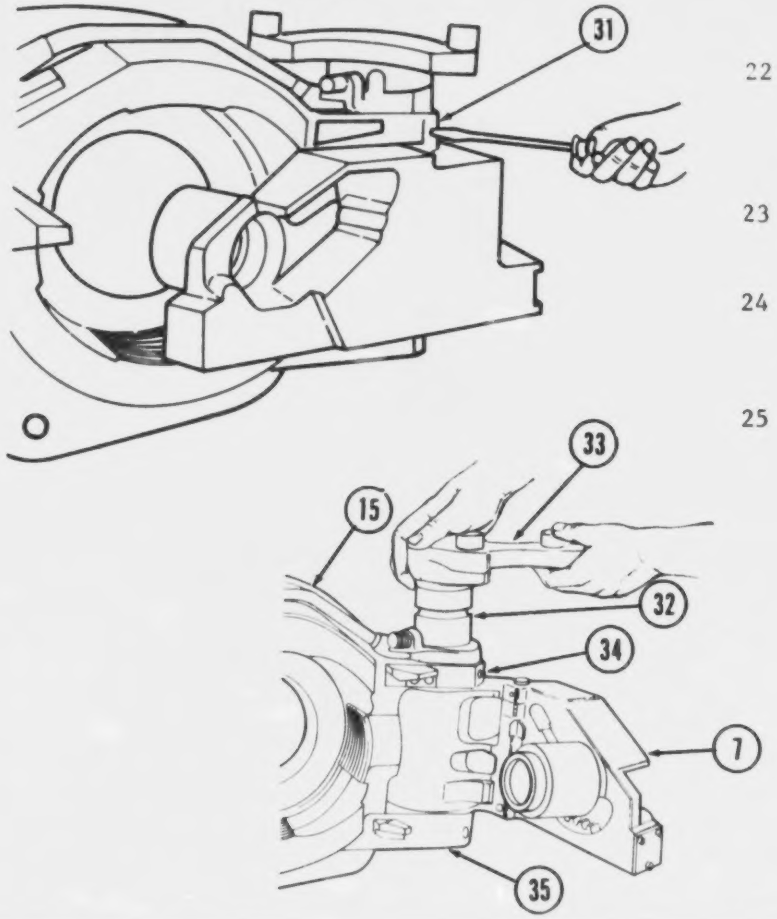


21 Remove leaf springs (29) by unscrewing adjuster detent (30) and lowering breechblock adjuster (1) containing leaf springs (29).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

a. Disassembly-Continued

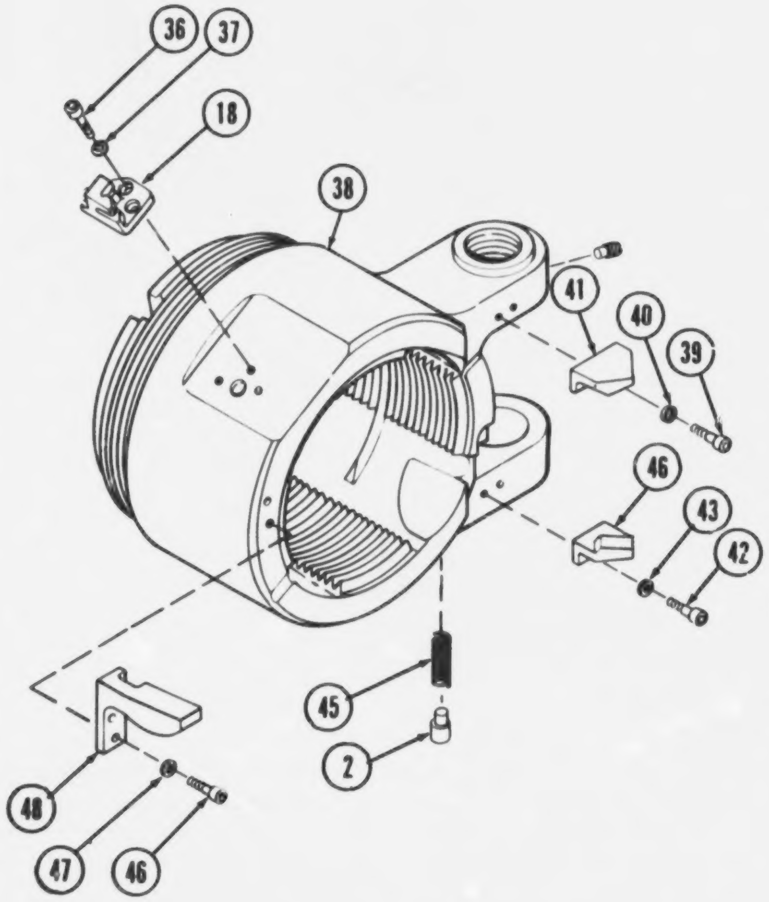


22 Unscrew breech ring upper lug detent (operating crank detent) (31), disengaging it from annular groove (32) of operating crank assembly (33).

23 Support carrier assembly (7) and lift out operating crank assembly (33).

24 Remove carier assembly (7) from upper breech ring lugs (34) and lower breech ring lugs (35).

25 Remove breech operating handle (15).



NOTE

Do not remove breech ring from cannon.

26 Remove three screws (26), three lock washers (37) and operating handle stop (18) from breech ring body (38). Discard three lock washers (38).

27 Remove two screws (39), two lock washers (40) and right catch (upper) (41). Discard two lock washers (40).

28 Remove two screws (42), two lock washers (43) and left catch (lower) (46). Discard two lock washers (43).

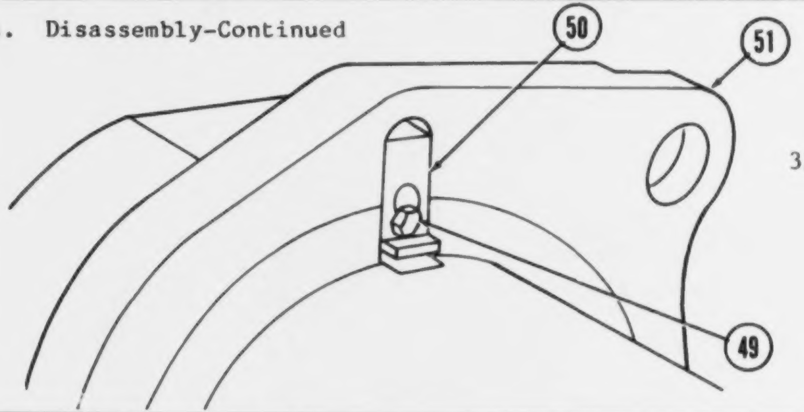
29 Remove closing mechanism adjusting plunger (2) and spring (45) only if damaged.

30 Remove two screw (46), two lock washers (47) and cam (48). Discard two lock washers (47).

MOUNT AND HOWITZER ASSEMBLY — Continued

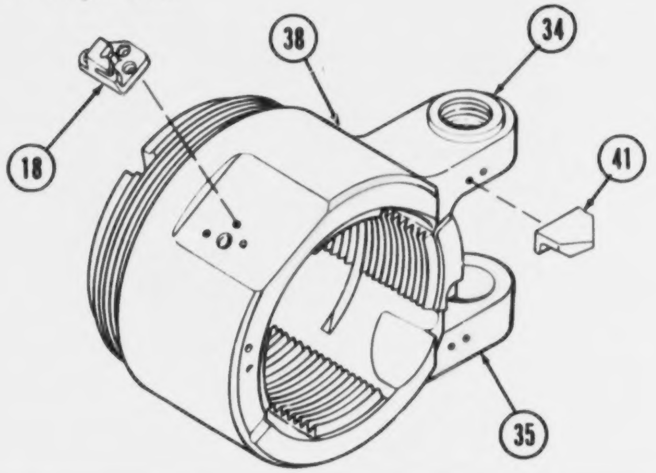
4-7. BREECH MECHANISM — Continued

a. Disassembly-Continued



31 Remove cap screw (49) and breech ring key (50) from front of breech ring band (51).

b. Inspection



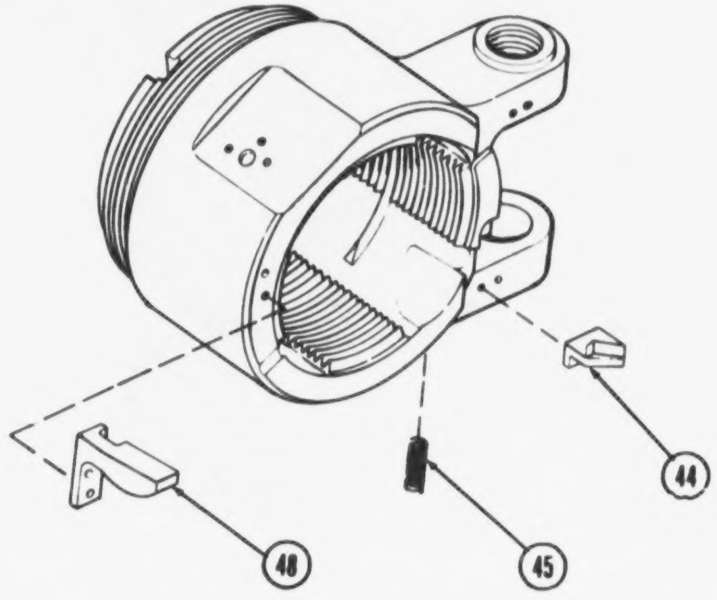
1 Replace breech ring body (38) with cannon assembly as required (ref. TM 9-1000-202-14).

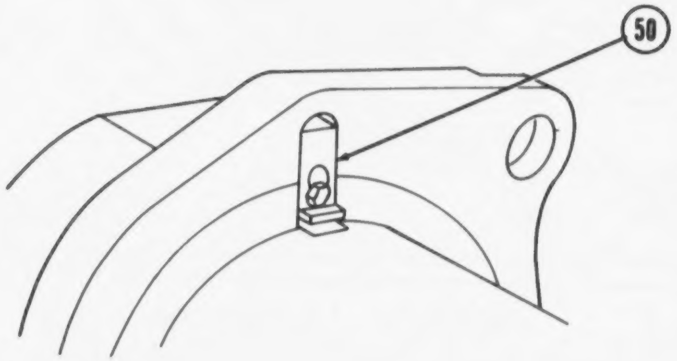
2 Measure inside diameter of upper breech ring lug (34) and replace if greater than 2.908 inches (76.3 mm).

3 Measure inside diametef of lower breech ring lug (35) and replace if greater than 3.005 inches (76.32 mm).

4 Inspect operating handle stop (18). Replace if cracked or deformed.

5 Inspect right catch (upper) (41). Replace if cracked or deformed.





6 Inspect left catch (lower)(44). Replace if cracked or deformed.

7 Inspect spring (45) and replace if distorted.

8 Measure spring (45) length under load of 15.5 pounds (7Kg) ± 10%. Replace if less than 1.125 inches (28.57 mm).

9 Measure spring (45) length under load of 8.0 pounds (3.6 Kg) ± 10%. Replace if less than 1.875 inches (47.62 mm).

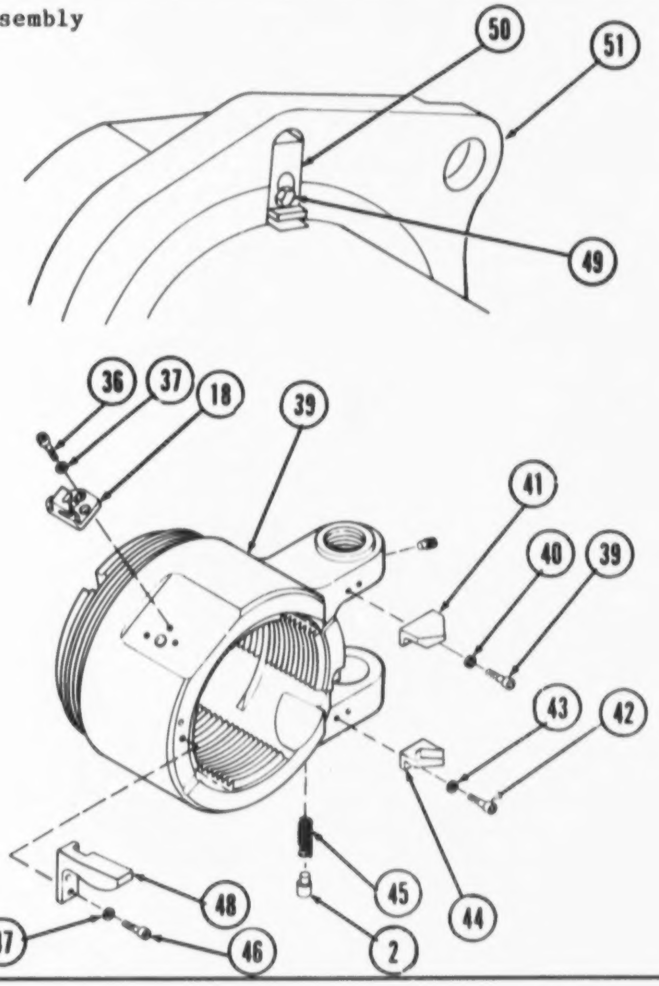
10 Inspect cam (48). Replace if cracked or distorted.

11 Inspect breech ring key (50). Replace if there are burrs, cracks, distortions or mutilations.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

c. Assembly



1 Install breech ring key (50) with cap screw (49) on breech ring band (51).

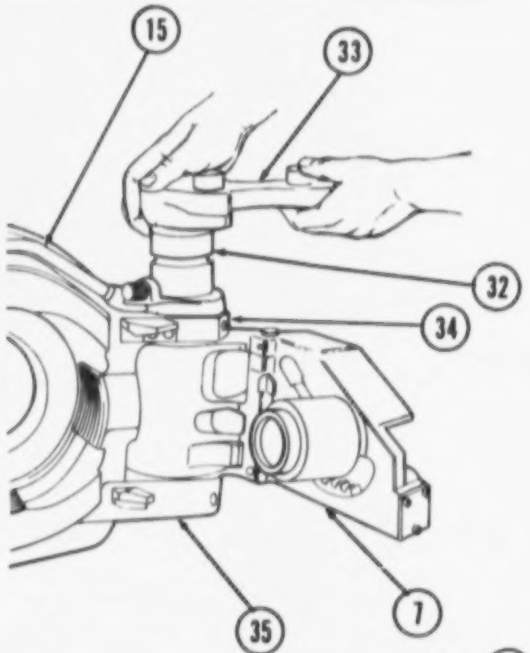
2 Install cam (48) with two new lock washers (47) and two screws (46).

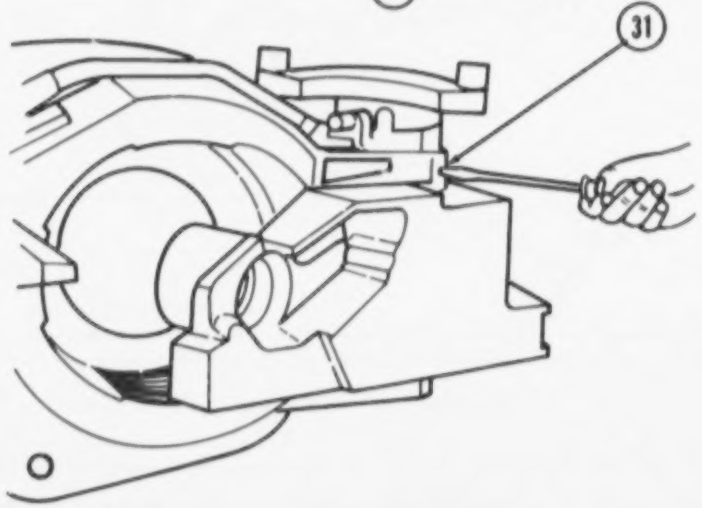
3 Install closing mechanism adjusting plunger (2) and spring (45) if it was removed during the disassembly procedure.

4 Install left catch (lower) (44) with two new lock washers (43) and two screws (42).

5 Install right catch (upper) (41) with two new lock washers (40) and two screws (39).

6 Install operating handle stop (18) with three new lock washers (37) and three screws (36).





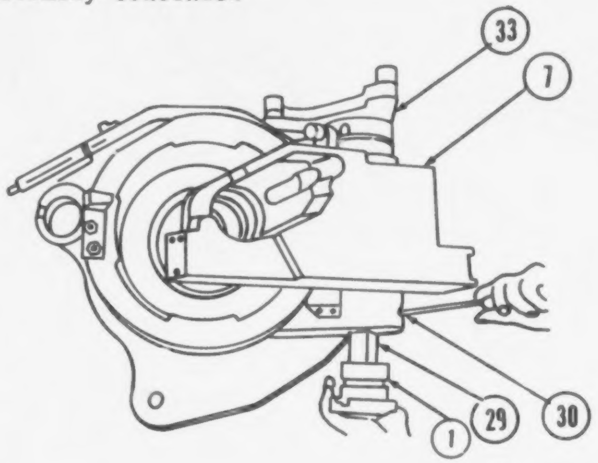
7 Position breech operating handle (15) and carrier assembly (7) so that operating crank assembly (35) can be inserted through breech operating handle (15), upper breech ring lug (34), carrier (7) and lower breech ring lug (35).

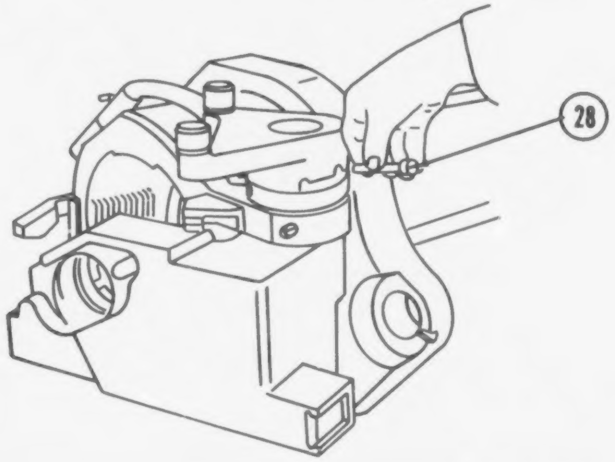
8 Screw in breech ring upper lug detent (operating crank detent) (31), engaging annular groove (32) of operating crank assembly (33).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

c. Assembly-Continued



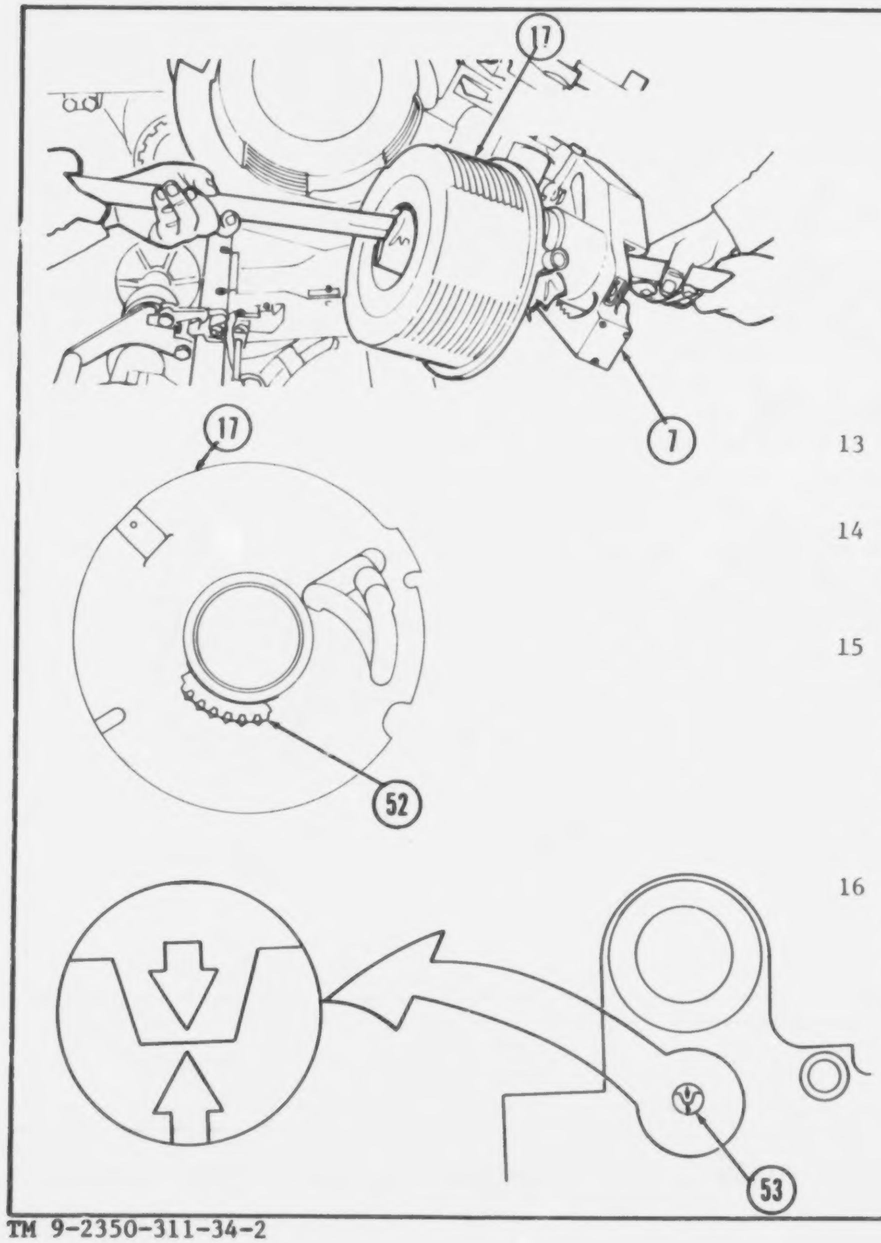


9 Install leaf springs (29) by first inserting leaf springs (29) into breechblock adjuster (1).

10 Raise leaf springs (29) into carrier assembly (7), alining hole in leaf springs (29) with hole in operating crank assembly (33).

11 Insert leaf spring torsion pin (28), making certain pin engages top hole of leaf springs (29).

12 Secure breechblock adjuster (1) by screwing in adjuster detents (30).



WARNING

Breechblock weighs approximately 125 pounds (57 kilograms). Two persons are needed to install breechblock to prevent injury to personnel.

13 Insert cleaning staff wrapped with rags through breechblock (17).

14 Support both ends of cleaning staff and lift breechblock (17). Position one end of cleaning staff into carrier assembly (7).

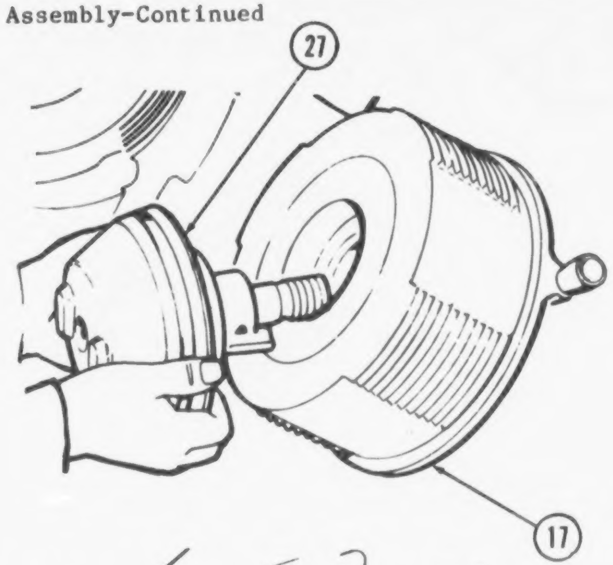
15 Position breechblock (17) on cleaning staff, so that arrow on breechblock sector gear crest (52) and carrier assembly gear rack root (53) are alined. If considered to be helpfull, mark breechblock (17) and carrier assembly (7) with felt tip marker to help maintain alinement

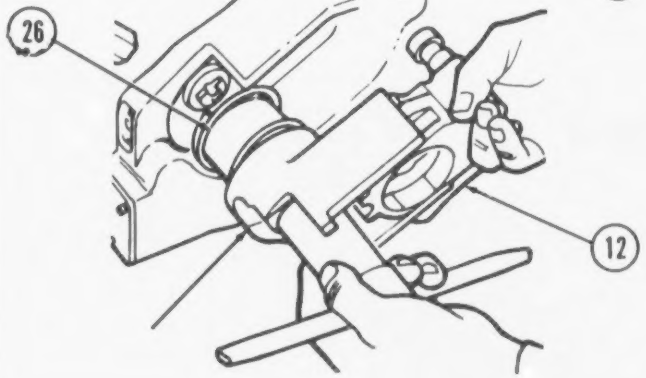
16 Slide breechblock (17) down cleaning staff onto position on carrier assembly (7), taking care to maintain alinement of arrow on breechblock sector gear crest (52) and carrier assembly gear rack root (53).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

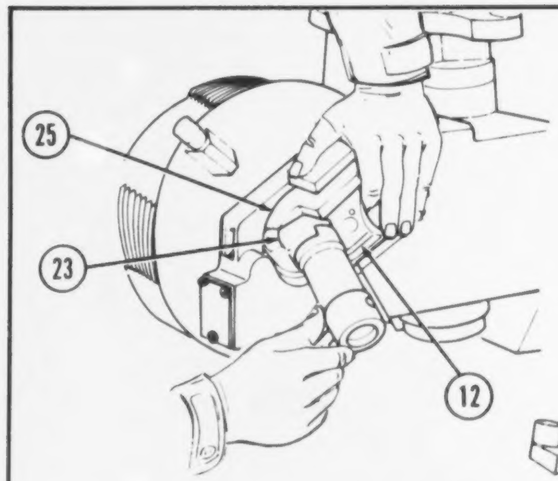
c. Assembly-Continued



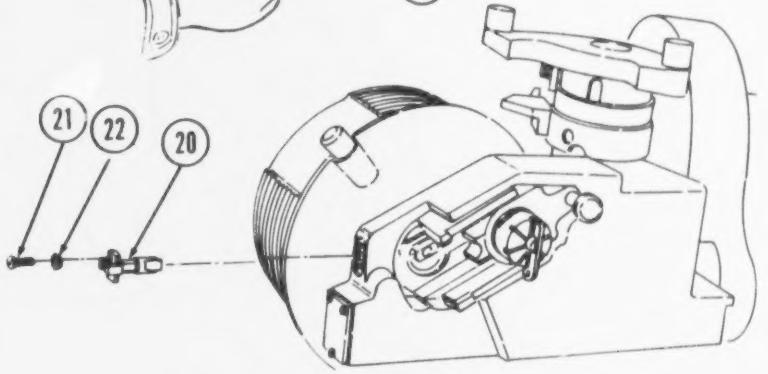


17 Install obturator spindle assembly (27) into breechblock (17).

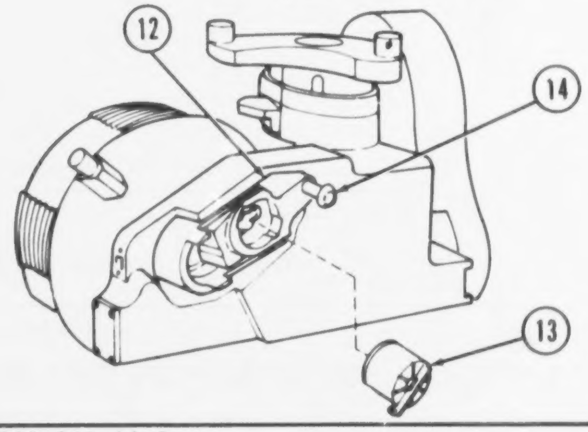
18 Install obturator spindle spring (26), firing mechanism housing group (25) and firing group block (12).



19 Secure firing group block (12) and firing mechanism housing (25) by installing obturator spindle nut (23). Use spanner wrench (ref. page 4-98) to install obturator spindle nut (23).



20 Install plunger assembly (20) with two new lock washers (22) and two screws (21).

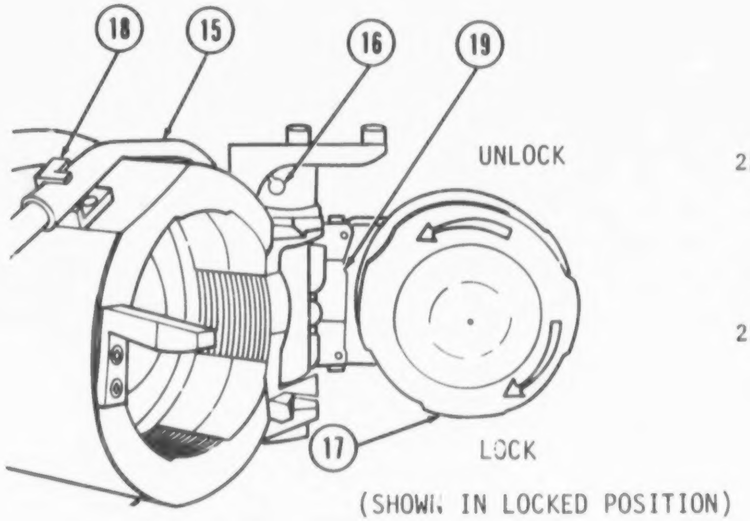


21 Pull out knob (14) and move firing group block (12) to center position. Install firing mechanism (13) by pushing in and rotating counterclockwise 70°.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM – Continued

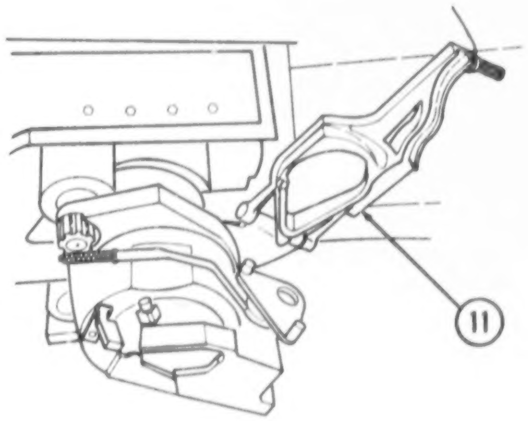
c. Assembly-Continued

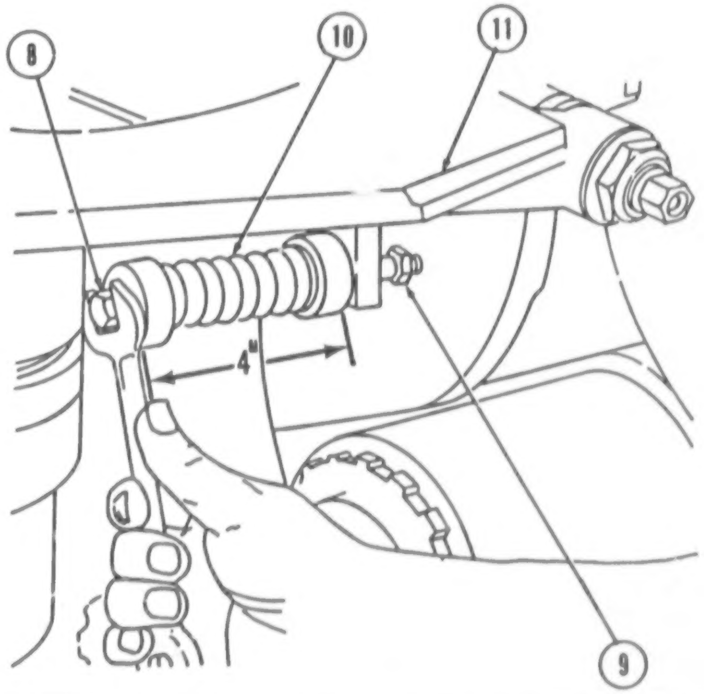


(SHOWN IN LOCKED POSITION)

22 Rotate breechblock (17) to UNLOCKED position. Make sure carrier detent plunger (19) extends.

23 Disengage breech operating handle (15) from operating handle stop (18), engage clutch pin (16) and close breech block (17).





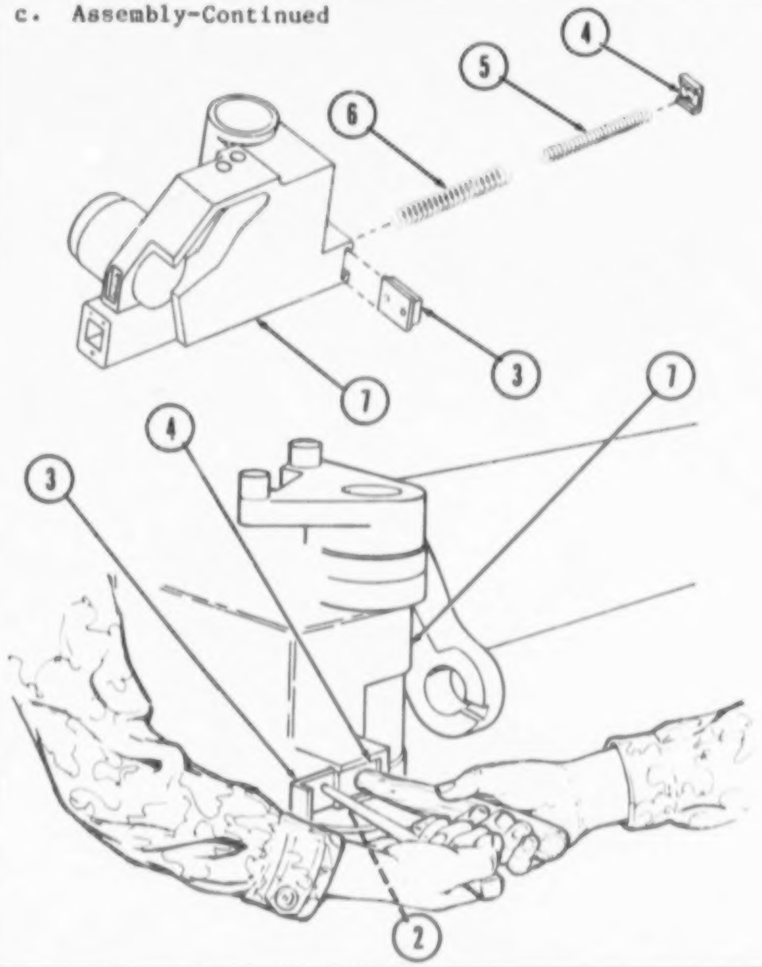
24 Lower breech mechanism operating cam (11) by removing rope.

25 Install damper assembly (10), hex head bolt (8) and jam nut (9). Adust to length of 4 inches end cap-to-end cap. Tighten jam nut (9).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-7. BREECH MECHANISM — Continued

c. Assembly-Continued



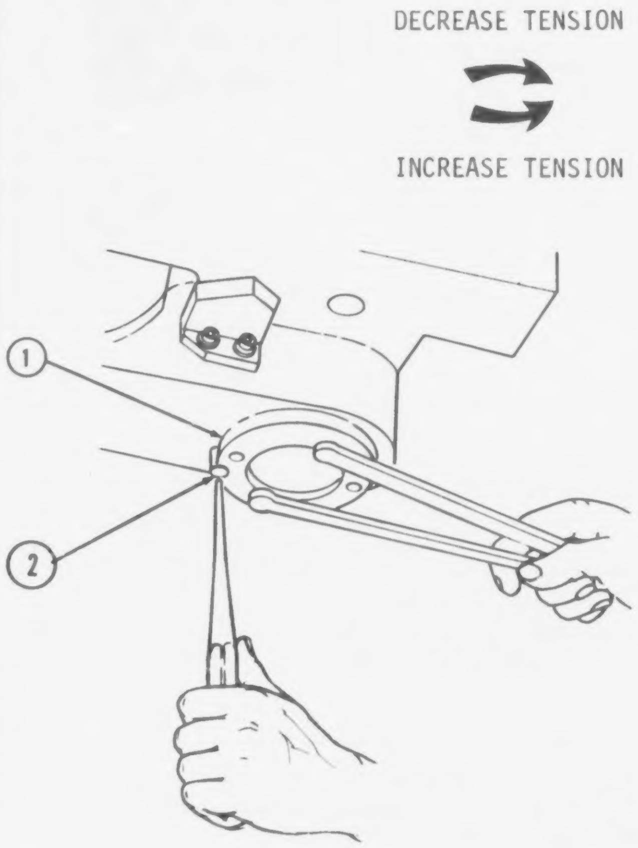
WARNING

UNDER NO CIRCUMSTANCES will the installation of springs be attempted with breechblock open. Springs are under heavy pressure and can cause severe injury if installed improperly.

26 Remove rack plate (3) and install rack spring (6 and 5) into carrier assembly (7).

27 Using a wooden dowel or wood hammer handle of suitable size, apply pressure slowly to the stop plate (4) until rack springs (6 and 5) and stop plate (4) are inside carrier assembly (7).

28 Depress closing mechanism adjusting plunger (2) with punch and slide rack plate (3) until rear hole engages closing mechanism adjusting plunger (2) (hidden).



NOTE

- The breechblock adjuster has two or three steps which provide three graduations of adjustment. During installation, do not apply more preload than necessary to close breechblock securely.
- Some adjusters have lugs; use an adjustable wrench on these lugs.

29 Depress closing mechanism adjusting plunger (2) with punch. Increase tension (preload) by placing jays of spanner wrench in holes of breechblock adjuster (1) and turning counterclockwise. Do not apply more preload than necessary to close breechblock securely.

NOTE

For installation of the direct fire telescope, refer to TM 9-2350-311-20-2.

MOUNT AND HOWITZER ASSEMBLY — Continued

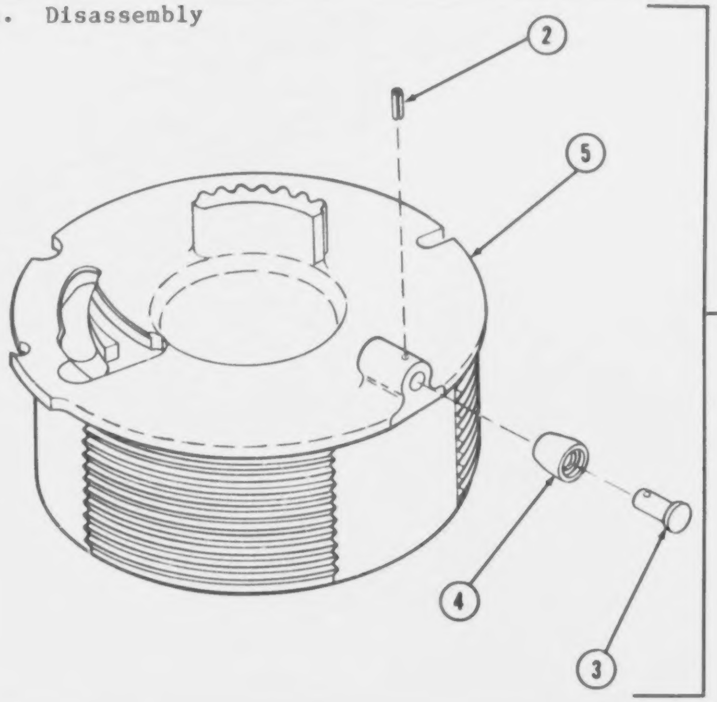
4-8. BREECHBLOCK ASSEMBLY

This task covers: a. Disassembly b. Inspection and Repair c. Assembly

INITIAL SET-UP

Materials/Parts	Test Equipment
Spring pin	Micrometer, inside Micrometer, outside

a. Disassembly



WARNING

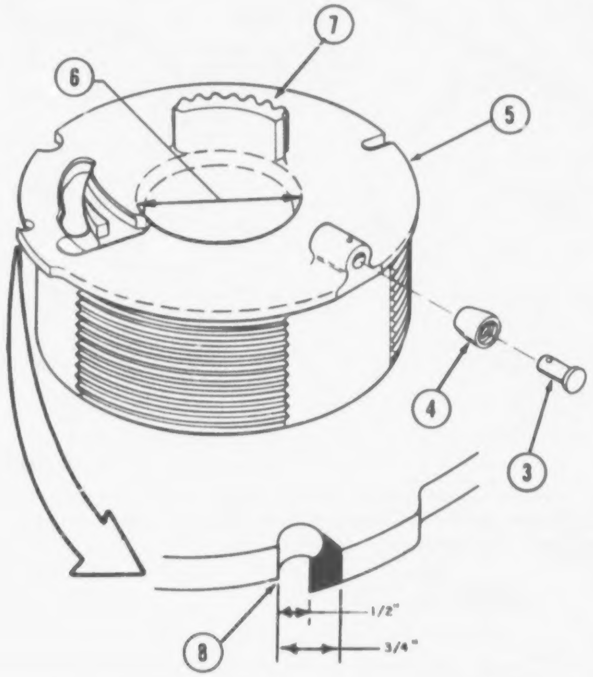
Breechblock weighs approximately 125 pounds (57 kilograms). Wear safety shoes to prevent injury.

1 Remove breechblock assembly (1) (ref. page 4-96). Place breechblock assembly (1) on solid surface.

2 Remove spring pin (2).

3 Remove pivot (3) and roller (4) from breechblock (5).

b. Inspection and Repair



1 Inspect breechblock (5) for damaged threads. Repair threads or replace breechblock (5).

2 Measure breechblock (5) hole diameter (6). Replace if greater than 4.314 inches (109.6 mm)

3 Inspect gear segment of breechblock (7). Replace breechblock if damaged or distorted.

4 Replace roller (4) if broken, cracked, or if outside diameter is less than 0.995 inch (25.3 mm) or if inside diameter is greater than 0.5 inch (12.7 mm).

5 Inspect pivot (3). Replace if damaged or distorted.

6 Inspect width of notch (8). New part width is 1/2 inch (12.7 mm). If notch width is worn greater than 3/4 inch (19 mm), replace breechblock (5).

c. Assembly

1 Install roller (4) and pivot (3) in breechblock (5).

2 Install new spring pin (2).

MOUNT AND HOWITZER ASSEMBLY — Continued

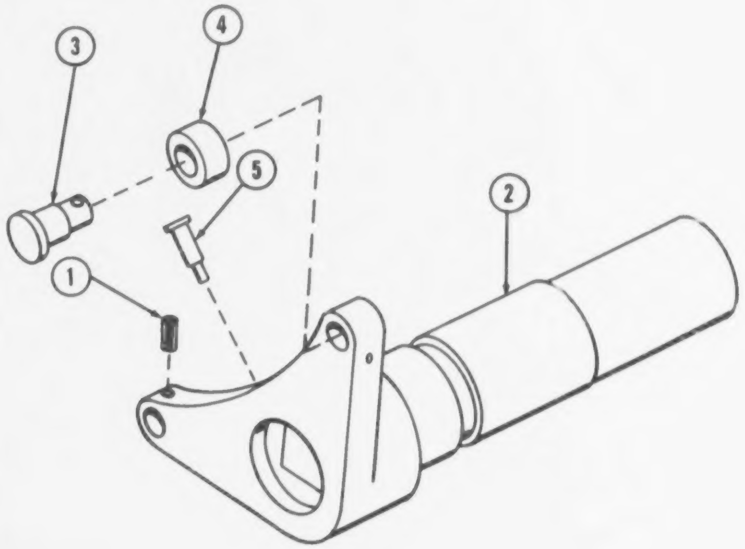
4-9. OPERATING CRANK ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts	Test Equipment
Spring pin	Calipers Micrometers, inside and outside

a. Disassembly



WARNING

Wear safety glasses and safety shoes to prevent injury due to falling or flying objects.

NOTE

Operating crank assembly should be removed prior to disassembly.

1 Remove two spring pins (1) from breech crank (2). Discard spring pins (1).

2 Remove two pins (3) and two rollers (4).

3 Remove leaf spring torsion pin (5).

b. Inspection

1 Inspect two pins (3) and replace if cracked or deformed. Measure outside diameter of pins (3) and replace if less than 0.873 inch (22.2 mm).

2 Inspect two rollers (4) and replace if cracked or deformed. Measure inside diameter of rollers (4) and replace if greater than 0.876 inch (22.3 mm). Measure outside diameter of rollers (4) and replace if less than 1.25 inches (31.7 mm).

3 Inspect leaf spring torsion pin (5) and replace if deformed or cracked.

4 Inspect breech crank (2) and replace if there are visible cracks. Measure outside diameter of breech crank (2) and replace if less than 2.89 inches (73.6 mm). Measure inside diameter of roller pin holes and replace breech crank (2) if greater than 0.69 inch (17.4 mm).

c. Assembly

1 Install leaf spring torsion pin (5).

2 Place breech crank (2) on solid surface.

3 Install two rollers (4) and two pins (3).

4 Install two new spring pins (1) to secure two rollers (4).

MOUNT AND HOWITZER ASSEMBLY — Continued

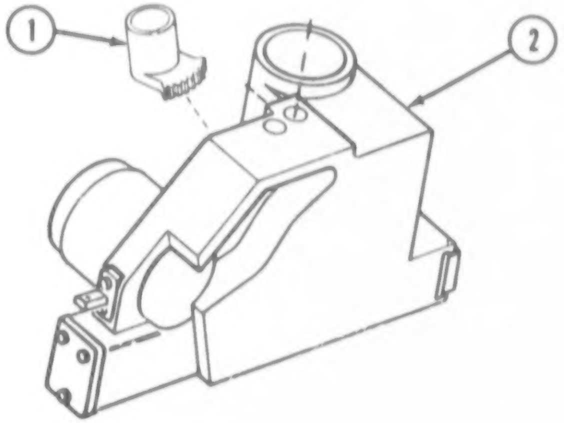
4-10. CARRIER ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts	Test Equipment
Lock washers	Calipers
Spring pin	Micrometer, inside

a. Disassembly

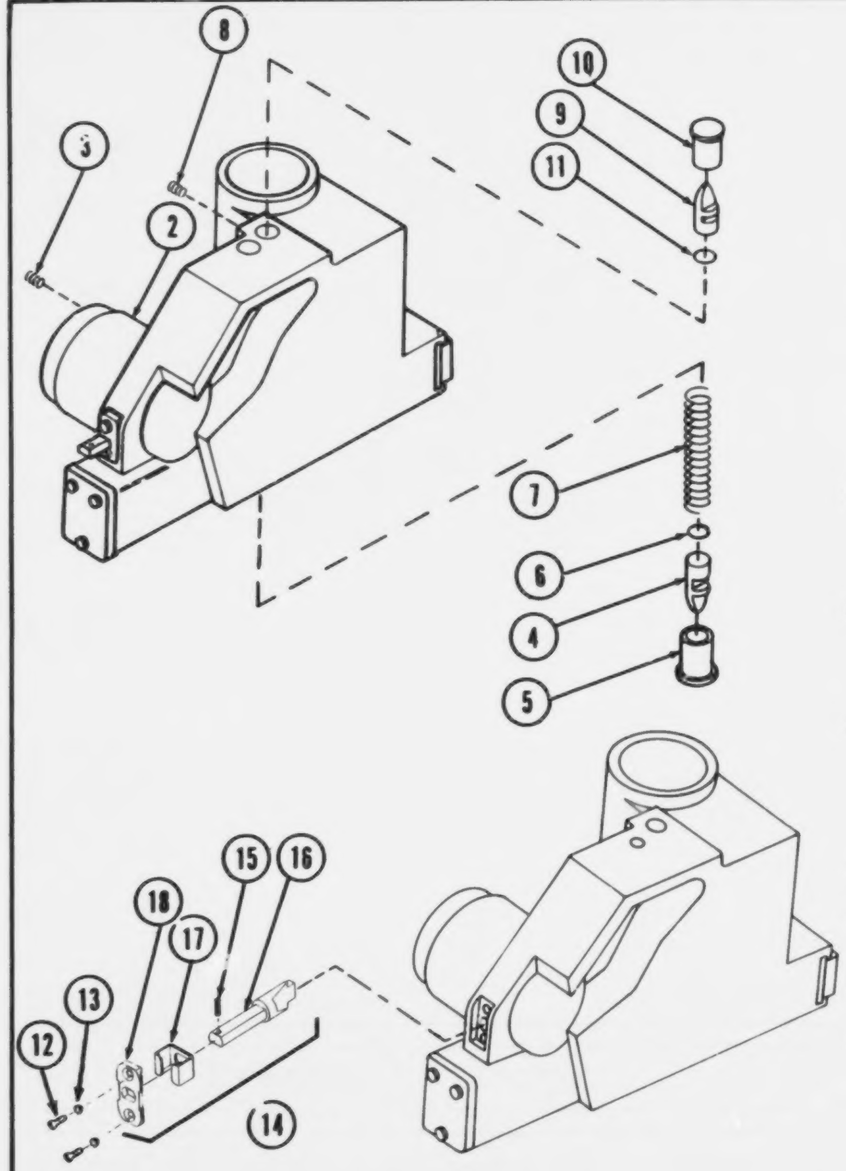


WARNING

Wear safety glasses and steel-tipped safety shoes to prevent injury.

1 Remove carrier assembly. Place carrier assembly on a solid work surface, breech side upward.

2 Remove spur gear (1) from carrier (2).



WARNING

Plungers hold compressed springs. Be careful to restrain plunger during disassembly to avoid injury. Wear safety glasses to prevent possible eye injury.

3 Restrain carrier assembly left plunger (4) while unscrewing left detent (3). Release carrier assembly left plunger (4) gradually.

4 Remove carrier assembly left plunger (4), left bushing (5), left disc (6) and spring (7) from carrier assembly housing (2).

5 Remove right detent (8), carrier assembly right plunger (9), right bushing (10) and right disc (11) from carrier assembly housing (2).

6 Remove two screws (12) and two washers (13).

7 Remove plunger assembly (14).

8 Remove spring pin (15) with a punch.

9 Remove plunger (16) and plunger clip (17) from plate (18).

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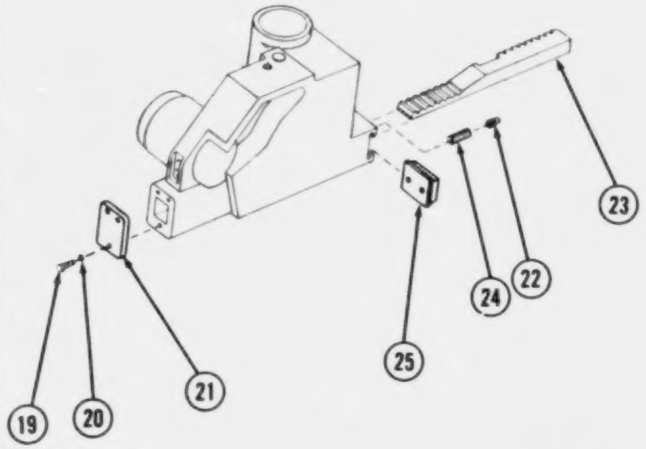
MOUNT AND HOWITZER ASSEMBLY — Continued

4-10. CARRIER ASSEMBLY — Continued

a. Disassembly-Continued



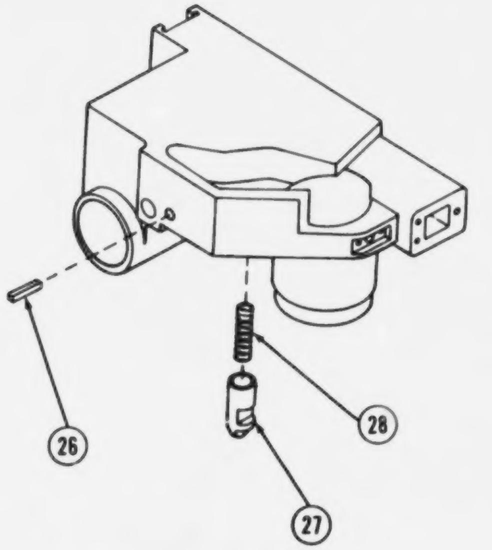
10 Remove three screws (19), three lock washers (20) and cover (21). Discard three lock washers (20).

11 Remove rack plate (22) and breech block rack gear (23).

NOTE

Plunger is staked in two places 180° apart. Do not remove unless damaged.

12 Remove plunger (24) and spring (25).



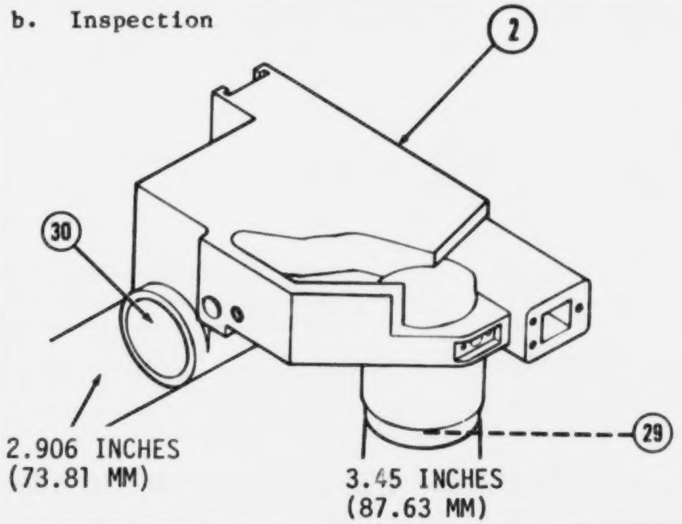
WARNING

Detent plunger is holding a compressed spring. Use care to restrain detent plunger during disassembly to avoid possible injury.

13 Remove spring pin (26) while restraining detent plunger (27) and detent plunger spring (28). Disgard spring pin (26).

14 Remove detent plunger (27) and detent plunger spring (28).

b. Inspection

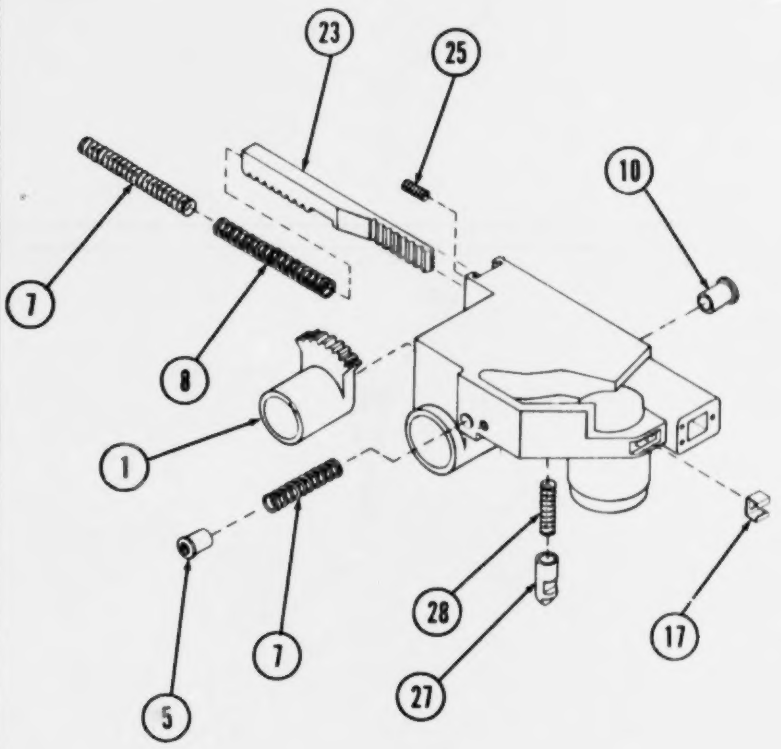


1 Inspect carrier assembly housing (2). Replace if nicked, cracked or burred. Measure inside diameter of spindle assembly hole (29) and replace if greater than 3.45 inches (87.63 mm). Measure inside diameter of crankshaft hole (30) and replace if greater than 2.906 inches (73.81 mm).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-10. CARRIER ASSEMBLY — Continued

b. Inspection-Continued



2 Inspect left and right bushings (5 and 10). Replace if they show excessive wear. Measure inside diameter of left and right bushings (5 and 10). Replace if greater than 0.1845 inches (4.686 mm).

3 Inspect spring (Item 7, page 4-125) and spring (Item 25 page 4-126) replace if deformed.

4 Inspect plunger clip (17). Replace if deformed.

5 Measure backlash of spur gear (1) and breechblock operating gear rack (23). Replace spur gear (1) and breechblock operating gear rack (23) if backlash is greater than 0.006 inch (0.152 mm).

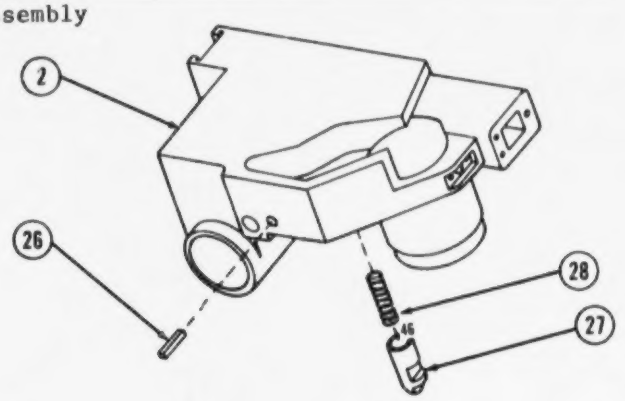
6 Inspect large rack spring (Item 6, page 4-99). Replace if distorted or cracked.

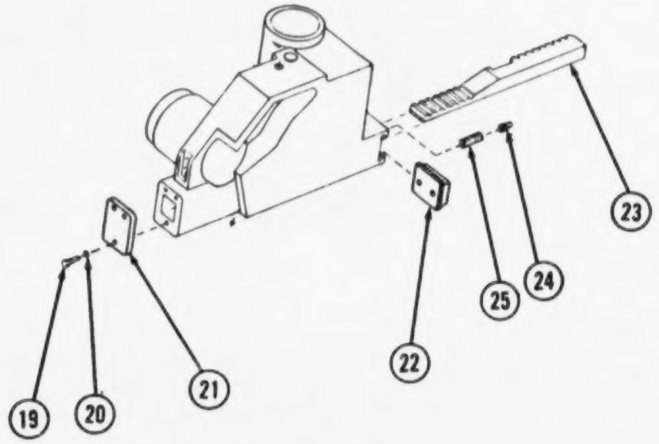
7 Inspect small rack spring (Item 5, page 4-99). Replace if distorted or cracked.

Inspect detent plunger spring (28). Replace if distorted or cracked.

9 Inspect and measure detent plunger (27). Replace if deformed more than 1/32 inch (0.793 mm).

c. Assembly





WARNING

Detent plunger holds a compressed spring. Use care to restrain detent plunger during assembly to avoid possible injury.

1 Install detent plunger spring (28), detent plunger (27) and spring pin (26).

2 Install cover (21) with three new lock washers (20) and three screws (19).

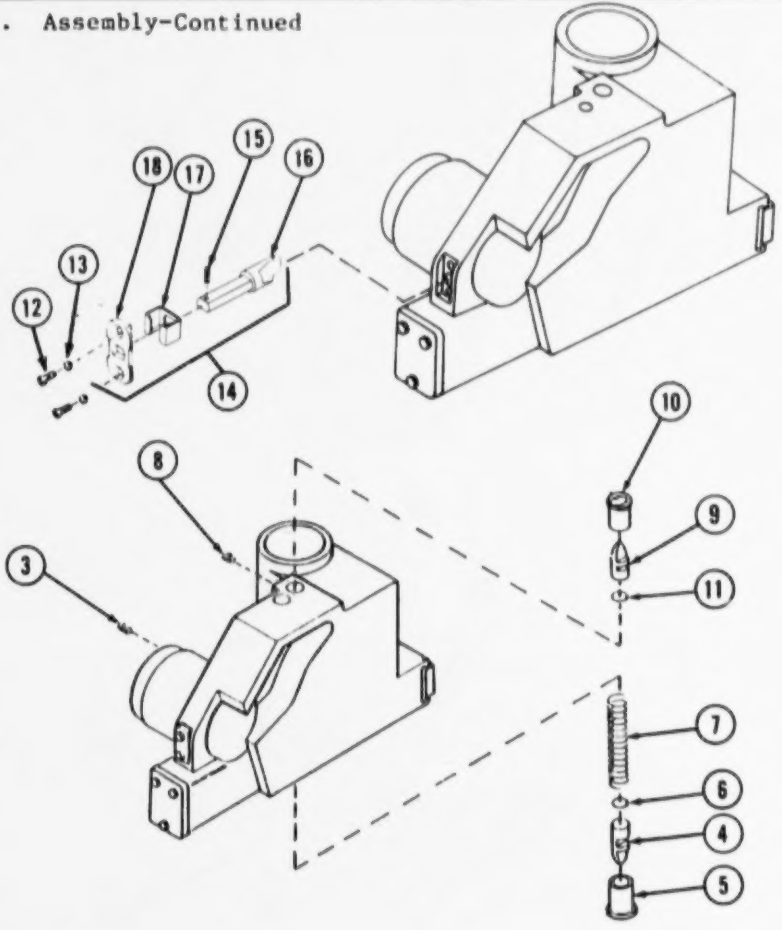
3 Install spring (25) and plunger (24). Stake plunger in two places 180° apart.

4 Install breechblock rack gear (23) and rack plate (22).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-10. CARRIER ASSEMBLY – Continued

c. Assembly-Continued



NOTE

Check for markings "L" and "R" to be sure plungers are installed in correct holes.

5 Install plunger clip (17) and plunger (16) to plate (18).

6 Install spring pin (15) thru plunger (16).

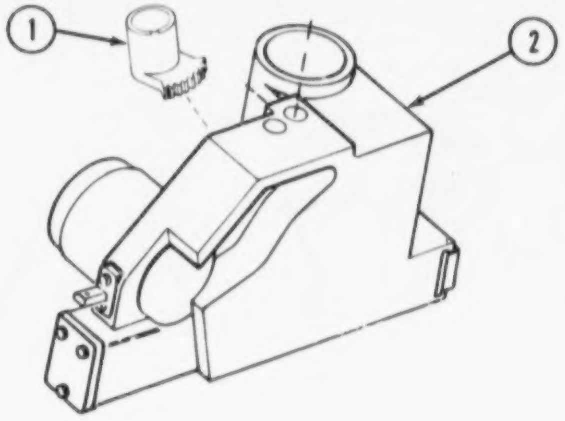
7 Install plunger assembly (14) with two new washers (13) and two screws (12).

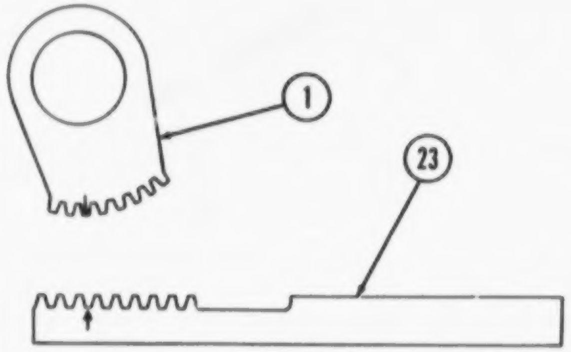
8 Install spring (7), left disc (6), left bushing (5) and carrier assembly left plunger (4).

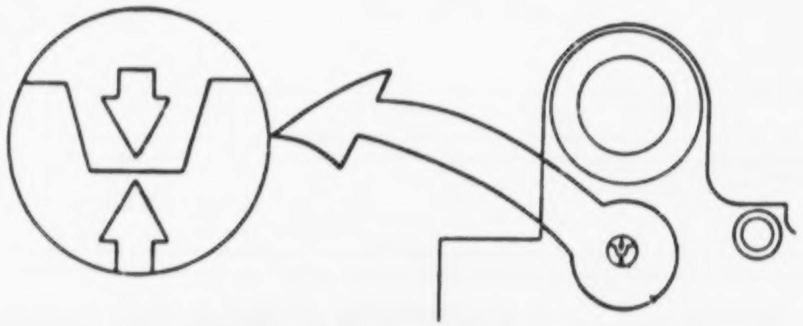
9 Install left detent (3) to restrain carrier assembly left plunger (4).

10 Install right disc (11), right bushing (10) and carrier assembly right plunger (9).

11 Install right detent (8) to restrain carrier assembly right plunger (9).







12 Install spur gear (1) into carrier assembly (2).

NOTE

- When installing spur gear (1) into carrier assembly (2), the arrow of the spur gear must be alined with arrow on rack gear (23). After arrows are alined on gear, center arrows in inspection hole at bottom of carrier before installing carrier on breech ring.
- If arrows are not visible on spur gear and rack gear, scribe third tooth of spur gear and third root of rack gear as shown.

13 Install carrier assembly (2) on breech ring and install remaining breech mechanism components (ref. page 4-111, step 7).

MOUNT AND HOWITZER ASSEMBLY — Continued

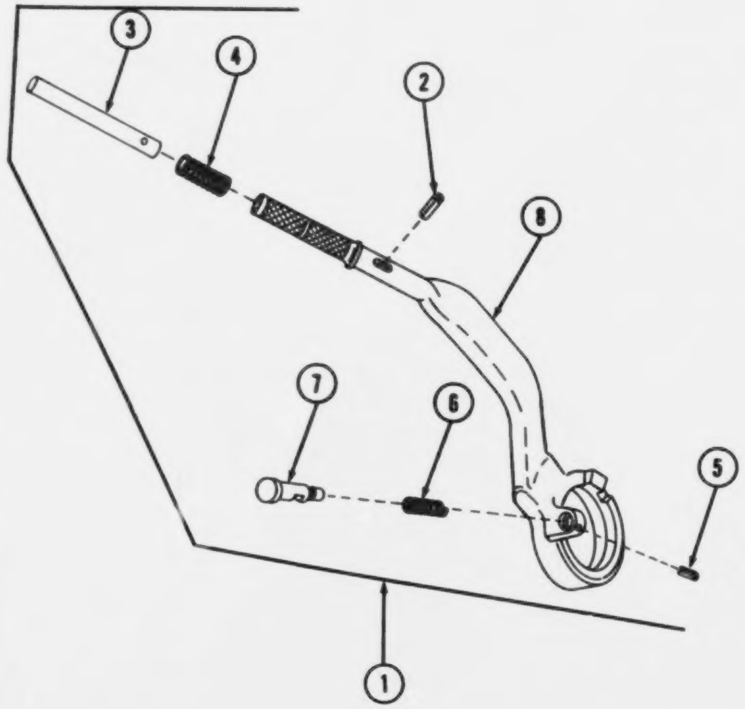
4-11. HANDLE ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts	Special Tools
Spring pins	Micrometer, inside

a. Disassembly



WARNING

Wear safety glasses and steel-tipped safety shoes to prevent injury.

1 Remove handle assembly (1).

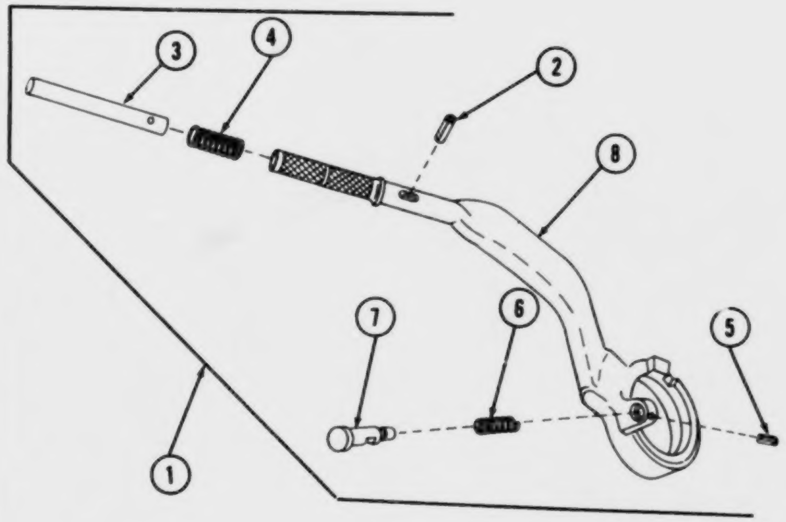
2 Place handle assembly (1) on a solid work surface. Actuate operating plunger (3) to see if it returns to LOCK position.

3 Remove spring pin (2), operating plunger (3) and helical spring (4) from breech handle (8). Discard pin (2).

4 Actuate closing clutch (7) to see if it returns to position when released.

5 Remove spring pin (5), closing spring (6) and closing clutch (7) from breech handle (8). Discard pin (5).

b. Inspection



1 Inspect helical spring (4). Replace if distorted or it failed to return operating plunger (3) to LOCK position when actuated during disassembly procedure.

2 Measure helical spring (4) length under a load of 3.0 pounds (1.3 Kg) ± 10%. Replace if less than 1.26 inches (32 mm).

3 Measure helical spring (4) length under a load of 6.0 pounds (2.7 Kg) ± 10%. Replace if less than 0.63 inches (16 mm).

4 Measure inside diameter (ID) of breech handle (8). Replace if greater than 3.741 inches (95.02 mm).

5 Inspect closing spring (6). Replace if distorted or it failed to return closing clutch (7) to proper position during disassembly procedure.

6 Measure closing spring (6) length under a load of 4.4 pounds (1.9 Kg) ± 10%. Replace if less than 0.96 inches (24.38 mm).

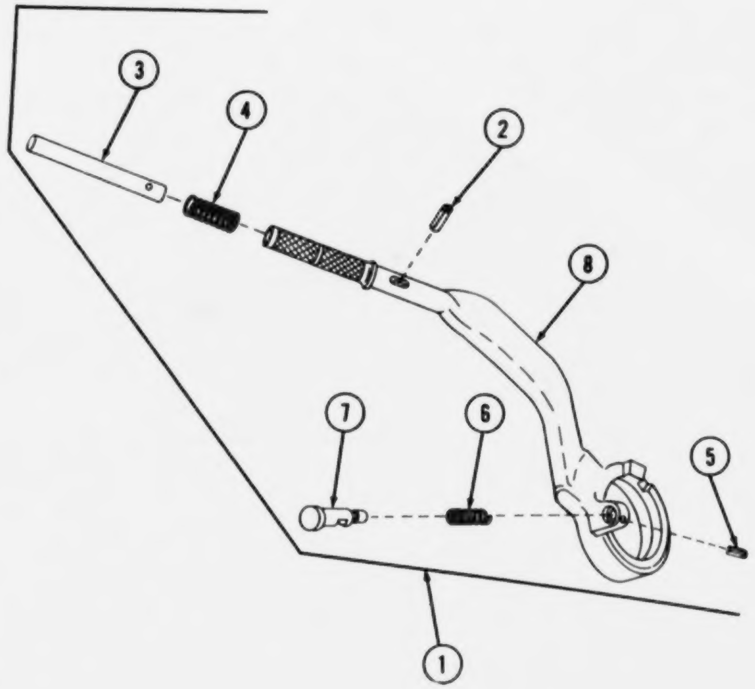
7 Measure closing spring (6) under a load of 8.0 pounds (3.6 Kg) ± 10%. Replace if less than 0.60 inches (9.14 mm).

8 Inspect closing clutch (7). Replace if nicked, distorted or cracked.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-11. HANDLE ASSEMBLY — Continued

c. Assembly



1 Install closing spring (6) and closing clutch (7). Secure by installing new spring pin (5).

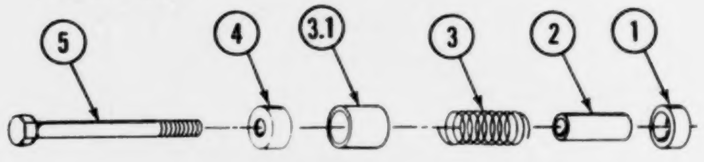
2 Install helical spring (4) and operating plunger (3). Secure operating plunger (3) by pushing into breech handle (8) and installing new spring pin (2).

3 Install handle assembly (1).

4-12. DAMPER ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

a. Disassembly



1 Remove damper assembly. (Ref. page 4-99.)

2 Remove cap (1), sleeve spacer (2), spring (3), stop (3.1), and cap (4) from bolt (5).

b. Inspection

Compress spring (3) under 450 ±20 pounds (204 ±9 kg). Measure its length. Replace if less than 3.312 inches (84 mm).

c. Assembly

1 Place cap (4), stop (3.1), spring (3), sleeve spacer (2) and cap (1) on bolt (5).

2 Install damper assembly. (Ref. page 4-116.)

MOUNT AND HOWITZER ASSEMBLY — Continued

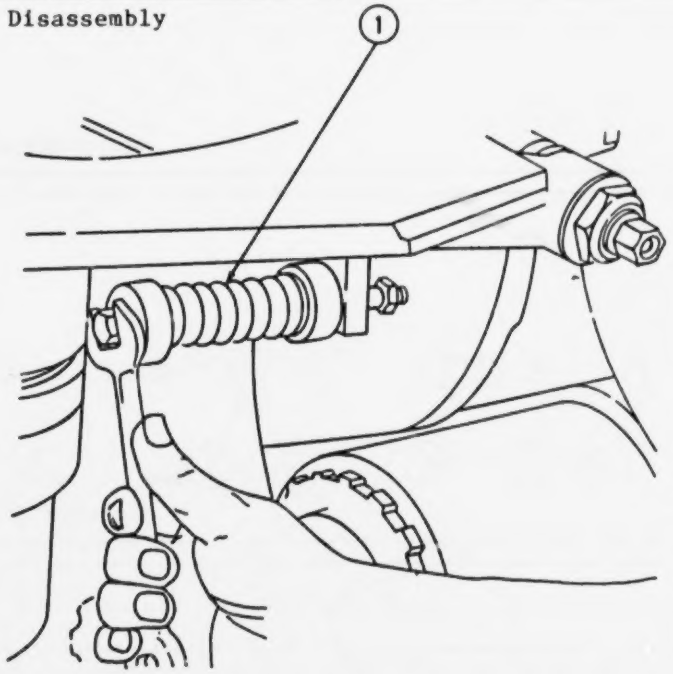
4-13. BREECH CAM AND PIN ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly/Replacement of Hinge Pin

INITIAL SET-UP

Materials/Parts	Special Tools	Test Equipment	Personnel Required
Bushings Spring pin	Hinge pin bushing driver (App. E)	Calipers Micrometers, inside and outside	2

a. Disassembly



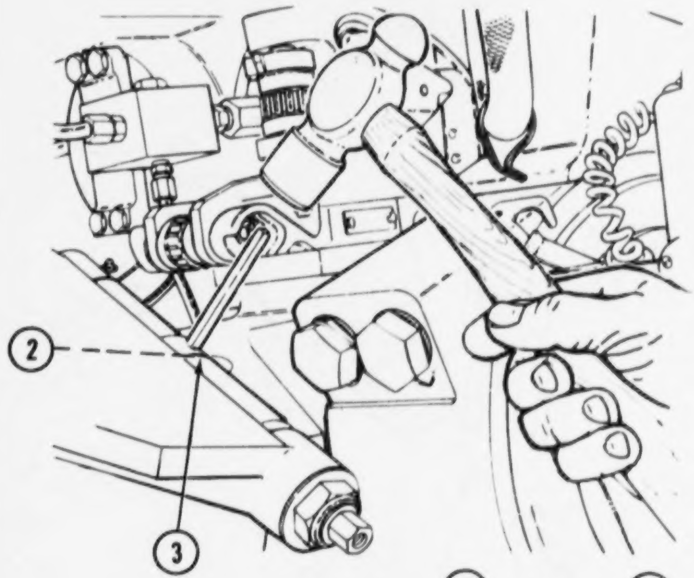
WARNING

Wear safety shoes, gloves and safety glasses to prevent injury.

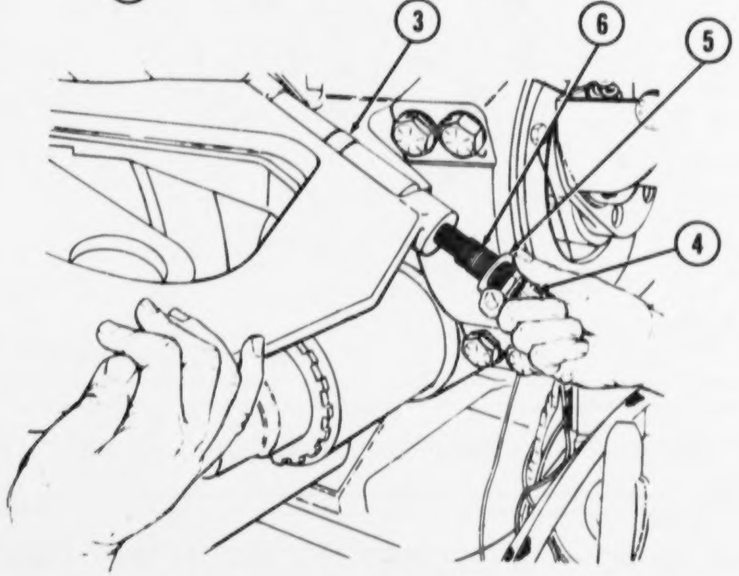
1 Remove elbow telescope M118A2 (ref. TM 9-2350-311-20-2).

2 Place cannon tube in travel lock (ref. TM 9-2350-311-10).

3 Remove damper assembly (1). (Ref. page 4-99.)



4 Drive out spring pin (2) from pin collar (3). Discard spring pin (2).

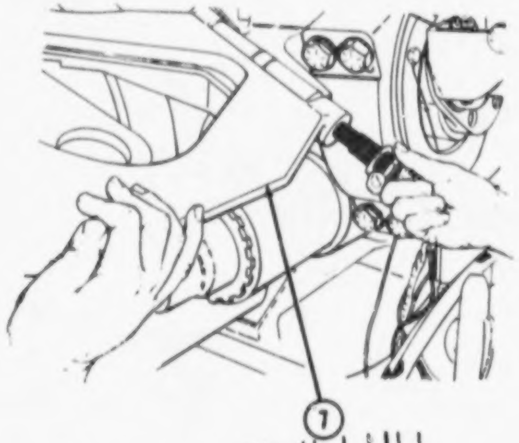


5 Remove cam breech pin locknut (4), washer (5), cam breech pin (6) and pin collar (3).

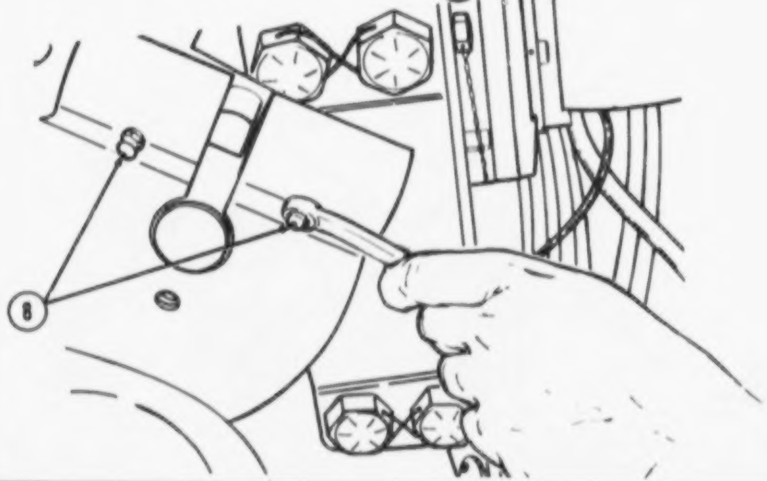
MOUNT AND HOWITZER ASSEMBLY — Continued

4-13. BREECH CAM AND PIN ASSEMBLY — Continued

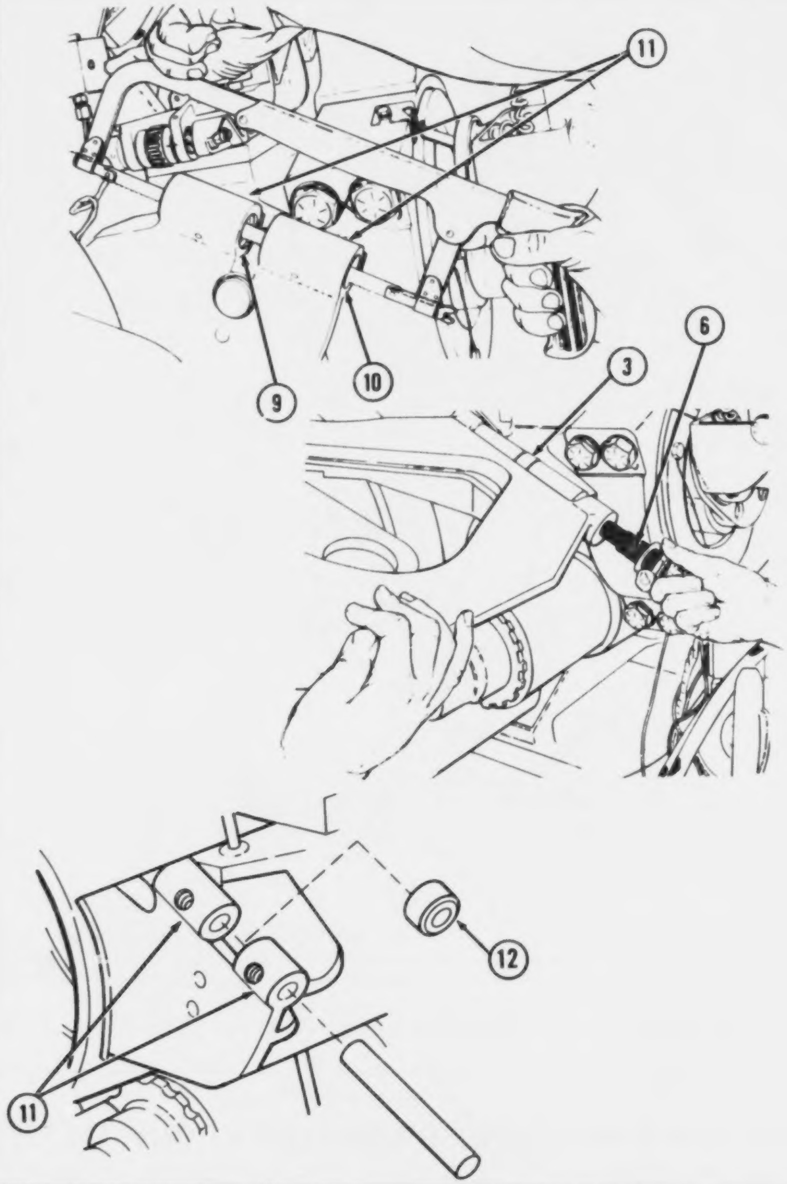
a. Disassembly-Continued



6 Lift off breech cam (7).



7 Remove two lubrication fittings (8).



8 Remove blade from hacksaw. Insert blade through bushings (9 and 10) in hinge (11). Assemble blade to hacksaw frame.

CAUTION

Use care not to damage inside of hinge when cutting bushings with hacksaw. Once bushings are cut, they can be driven out of hinge.

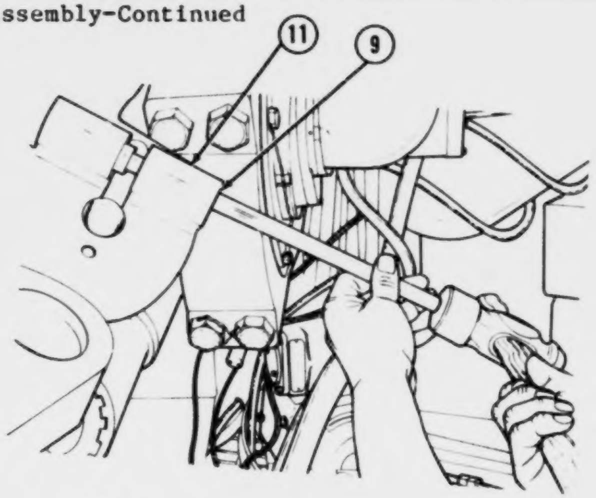
9 Cut bushings (9 and 10) through to hinge (11) in one place. Remove hacksaw from hinge (11). Discard bushings (9 and 10).

10 Obtain a steel rod with a diameter less than that of the cam breech pin (6). Obtain a capped bushing (12) of slightly less diameter than bushings (9 and 10). Insert capped bushing (12) into gap where pin collar (3) was. Insert steel rod into hinge (11).

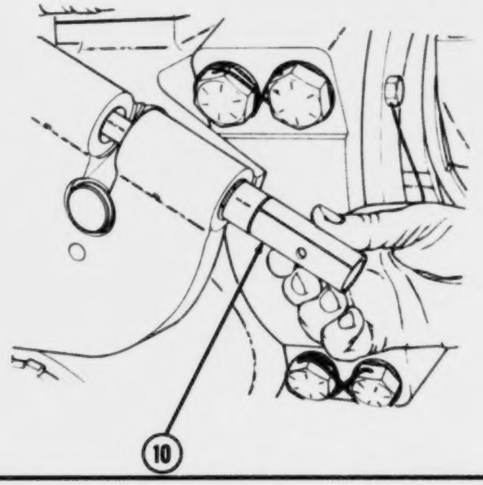
MOUNT AND HOWITZER ASSEMBLY — Continued

4-13. BREECH CAM AND PIN ASSEMBLY – Continued

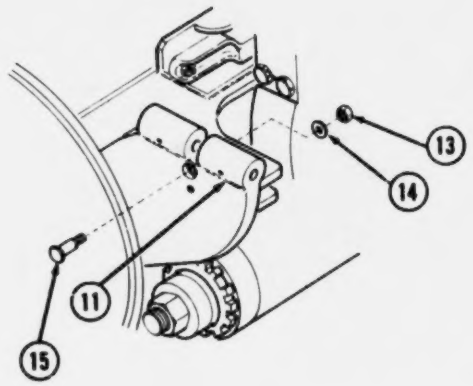
a. Disassembly-Continued



11 Drive left bushing (9) out of hinge (11).

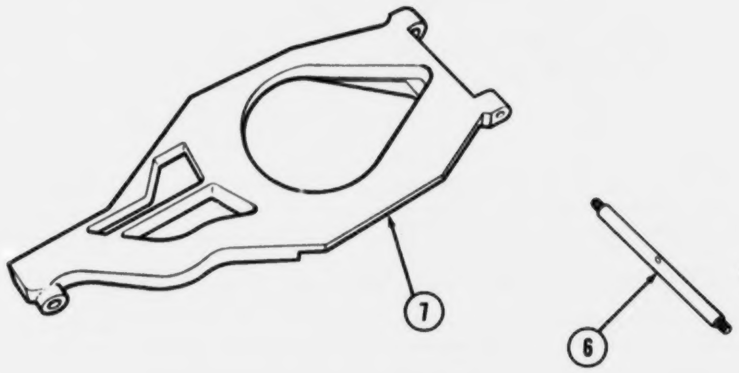


12 Repeat Step 10 and drive out right bushing (10).



13 Remove nut (13), washer (14) and cam stop (15) from mount below hinge (11).

b. Inspection



1 Measure outside diameter (OD) of cam breech pin (6) bearing surface. Replace if less than 0.748 inches (18.99 mm).

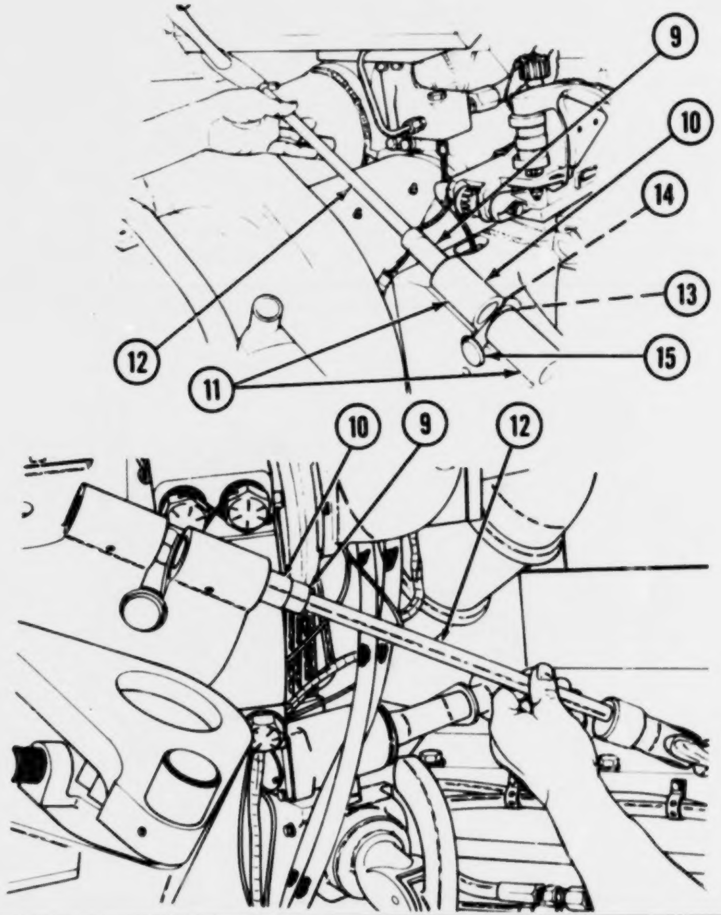
2 Measure inside diameter (ID) of left hinge pinhole of breech cam (7). Replace breech cam (7) if greater than 0.750 inches (19.05 mm).

3 Inspect breech cam (7). Replace if there are any cracks or if cam path is distorted.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-13. BREECH CAM AND PIN ASSEMBLY – Continued

c. Assembly/Replacement of Hinge Pin

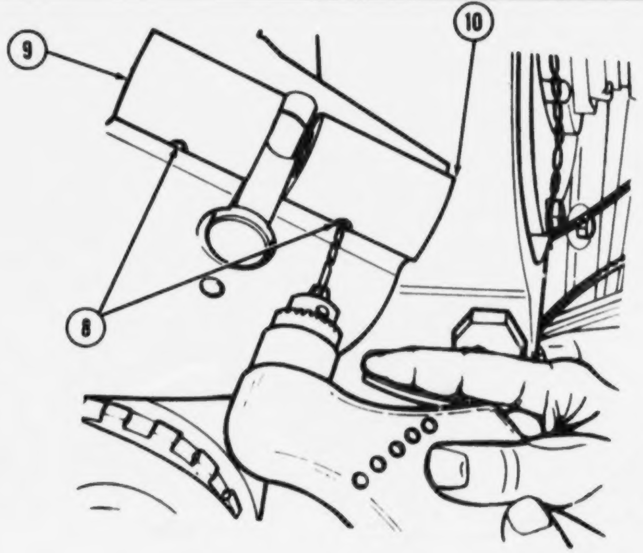


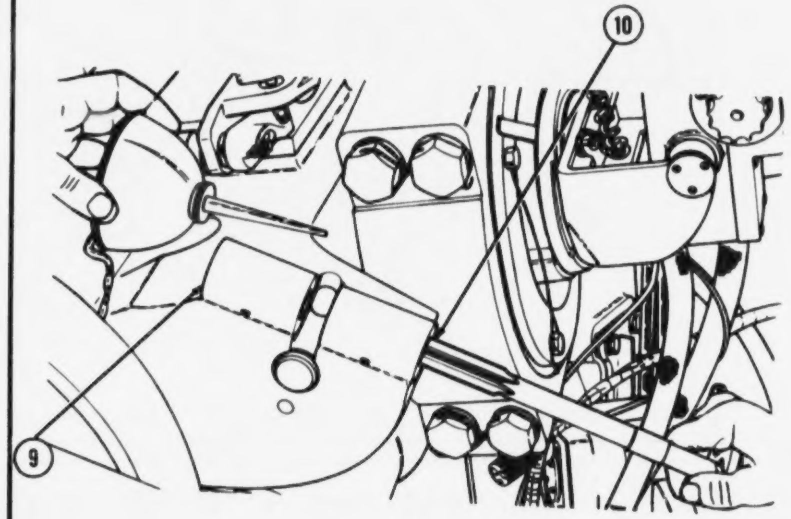
1 Install cam stop (15), washer (14) and nut (13) at mount below hinges (11).

2 Bore new bushings (9 and 10) to an inside diameter (ID) of 0.740 ±0.005 inches (18.79 ±0.12 mm).

3 Install new bushing (9) with hammer, steel rod and capped bushing (12).

4 Install new bushing (10) with hammer, steel rod and capped bushing (12).





CAUTION

Be careful not to damage threads in lubrication holes when drilling holes in new bushings. Remove all burrs from drilled holes in bushings.

NOTE

Use a 90° angle electrical drill. If not available, push cannon out of battery and use regular style drill (ref. TM 9-2350-311-20-2).

5 Drill 1/8 inch (3.1 mm) hole in new bushings (9 and 10) through lubrication fitting holes (8).

NOTE

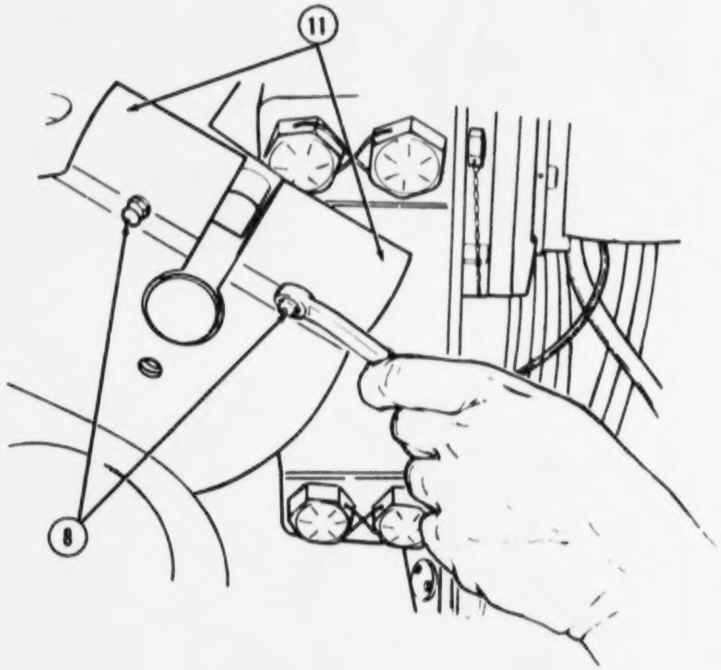
New bushings must be reamed in one operation as shown at left so they will be in line with each other.

6 Ream bushings (9 and 10) with a hand reamer, 3/4 inch (0.750 inches (19 mm)) in diameter.

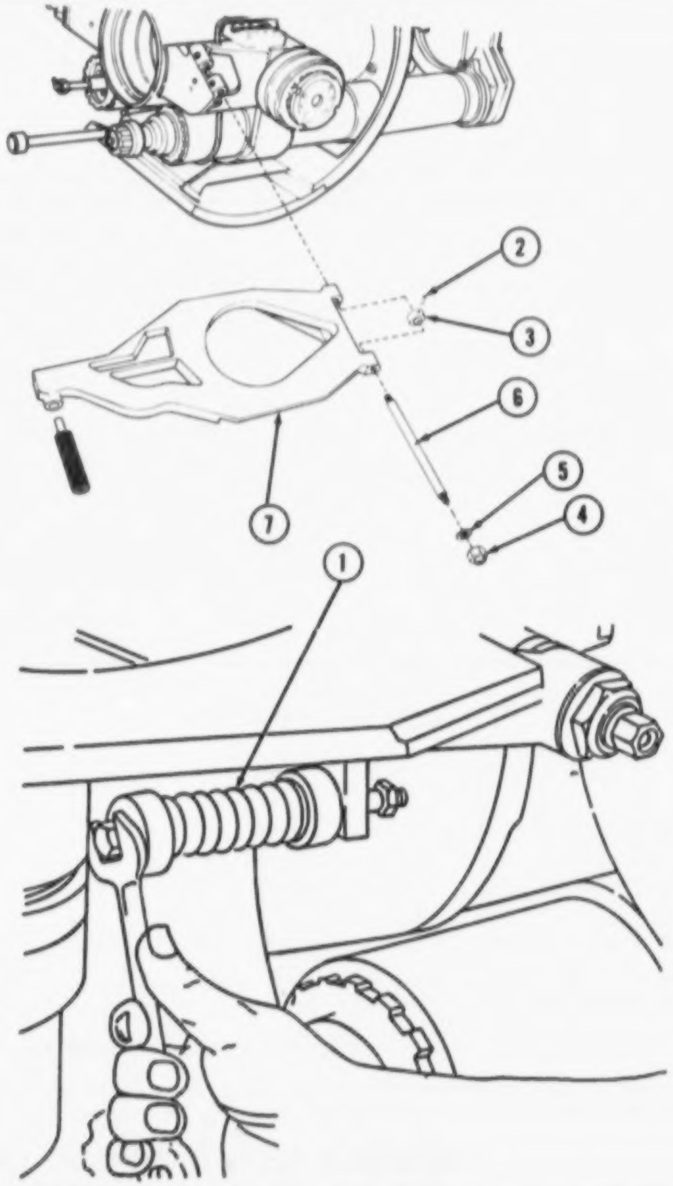
MOUNT AND HOWITZER ASSEMBLY — Continued

4-13. BREECH CAM AND PIN ASSEMBLY — Continued

c. Assembly/Replacement of Hinge Pin-Continued



7 Install two lubrication fittings (8) on hinges (11).



8 Lift breech cam (7) into position (holes in cam assembly alined with hinges (11)). Support breech cam (7).

9 Install cam breech pin (6) and pin collar (3). Make sure that holes in pin collar (3) are alined with holes in cam breech pin (6).

10 Install washer (5) and locknut (4). Do not tighten locknut (4) at this time.

11 Install spring pin (2) and tighten locknut (4).

12 Install damper assembly (1) on mount (ref. page 4-116).

13 Adjust horizontal and vertical cam operating assembly positions (ref. TM 9-2350-311-20-2).

MOUNT AND HOWITZER ASSEMBLY

4-14. RECUPERATOR ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection
d. Assembly e. Installation
f. Servicing with Hydraulic Fluid
g. Servicing with High Pressure Nitrogen - Method One
h. Servicing with High Pressure Nitrogen - Method Two

INITIAL SET-UP

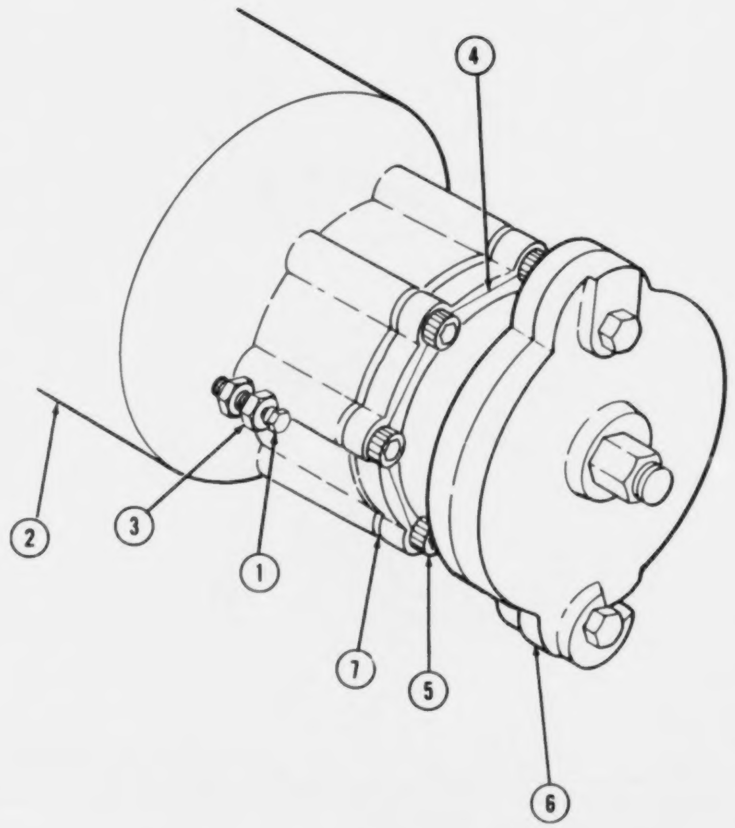
Materials/Parts
Parts kit, seal #5910845
Lock wire
Hydraulic fluid (Item 10, App. C)
Dry nitrogen (Item 18, App. C)
(Item 18, App. C)
Gaskets
Preformed packings
Cotter pins
Adhesive (Item 1, App. C)
Grease (Item 9, App. C)
Wood blocks
Nylon sling
Spring pins
Piston wiper
Seal assemblies

Test Equipment
Calipers
Micrometer

Special Tools
Nitrogen charging kit
(Item 11, App. B)
OR
Accumulator charging regulator
(Item 10, App. B)
Breech stand (App. E)

Personnel Required
Three for removal and installation

a. Removal



WARNING

- Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.
- Level cannon before venting nitrogen to avoid serious injury to personnel or damage to equipment caused by cannon sliding out of battery.
- Keep all parts of body clear to prevent serious injury when venting nitrogen. High pressure nitrogen must be completely vented before the drain plug is loosened to prevent serious injury caused by escaping hydraulic fluid.

1 Depress cannon to 0 mils.

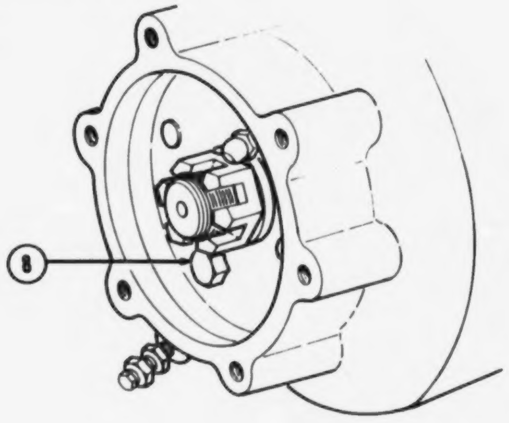
2 Remove nitrogen valve cap (1) from right front of recuperator cylinder (2) and loosen nut (3) on nitrogen valve cap (1) two turns to release nitrogen. Replace nitrogen valve cap (1) when recuperator cylinder (2) has been vented completely.

3 Remove lock wire (4) from six screws (5). Remove six screws (5), cover adapter group (6) and gasket (7) from front end of recuperator cylinder (2). Discard gasket (7) and lock wire (4).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

a. Removal-Continued



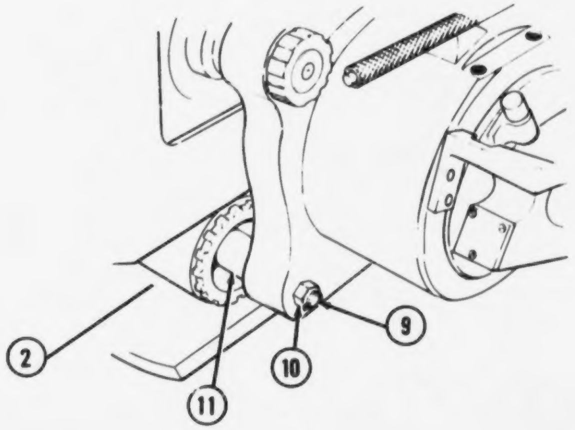
4 Loosen front drain plug (8) and catch fluid in a shallow drain pan. When fluid is drained, tighten front drain plug (8).

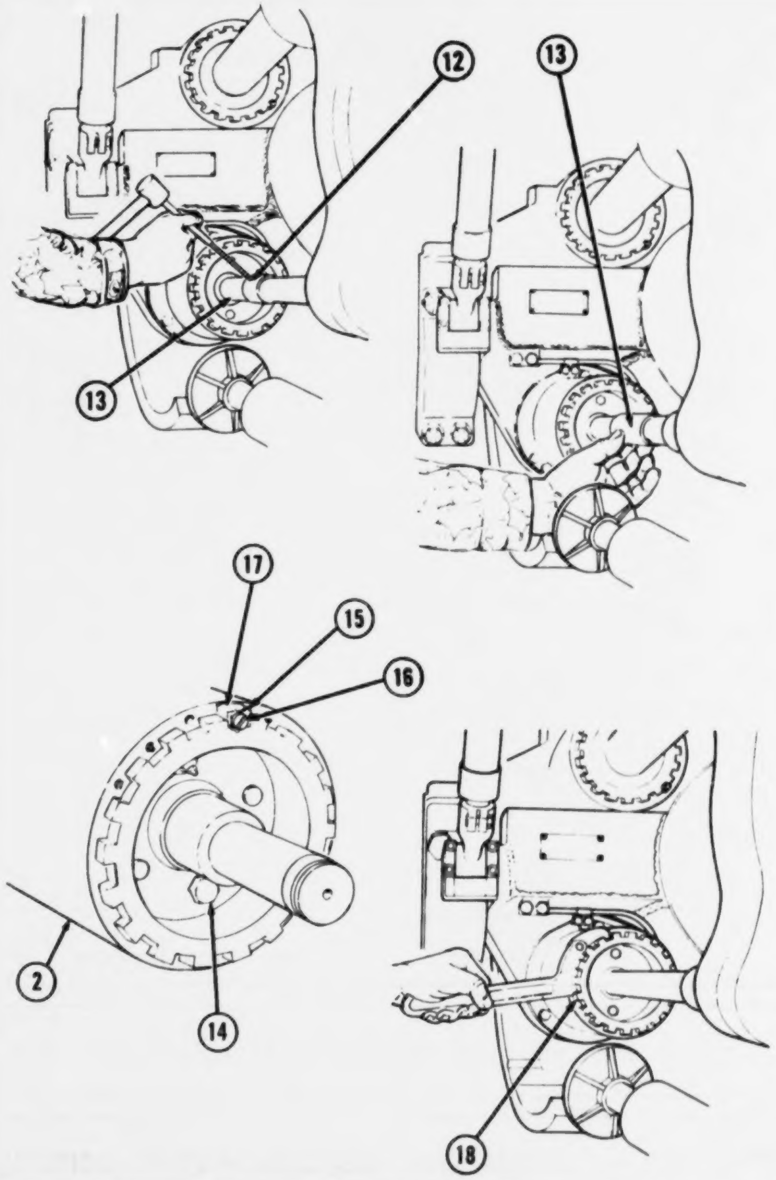
5 Remove cotter pin (9) and rear slotted nut (10) from shouldered shaft (11). Discard cotter pin (9).

WARNING

Block cannon with breech stand (App. E) or chain tube to hull when working on mount components with cannon pushed out of battery. This will prevent serious injury or damage to equipment caused by accidental elevation of the cannon.

6 Push cannon out of battery about 18 inches (457 mm) (ref. TM 9-2350-311-20-2).





7 Remove spring pin (12) with suitable punch. Discard spring pin (12).

8 Unscrew and remove shaft collar (13).

9 Remove drain plug (14) at rear of recuperator cylinder (2) and drain hydraulic fluid. Reinstall drain plug (14).

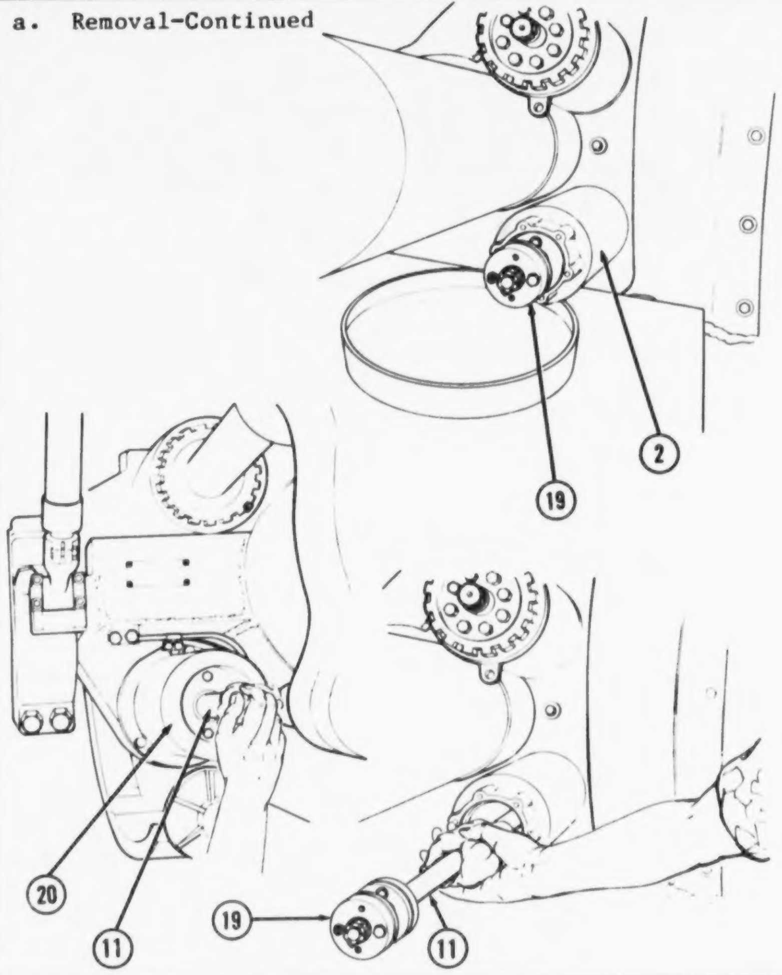
10 Remove lock wire (15), screw (16) and key (17). Discard lock wire (15).

11 Remove retaining ring (18) using spanner wrench.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

a. Removal-Continued



CAUTION

Use care not to damage threads on rear of shaft.

12 Push shouldered shaft (11) forward into recuperator cylinder (2). As piston group (19) comes out of front of recuperator cylinder (2) (outside cab), it must be supported by a second soldier.

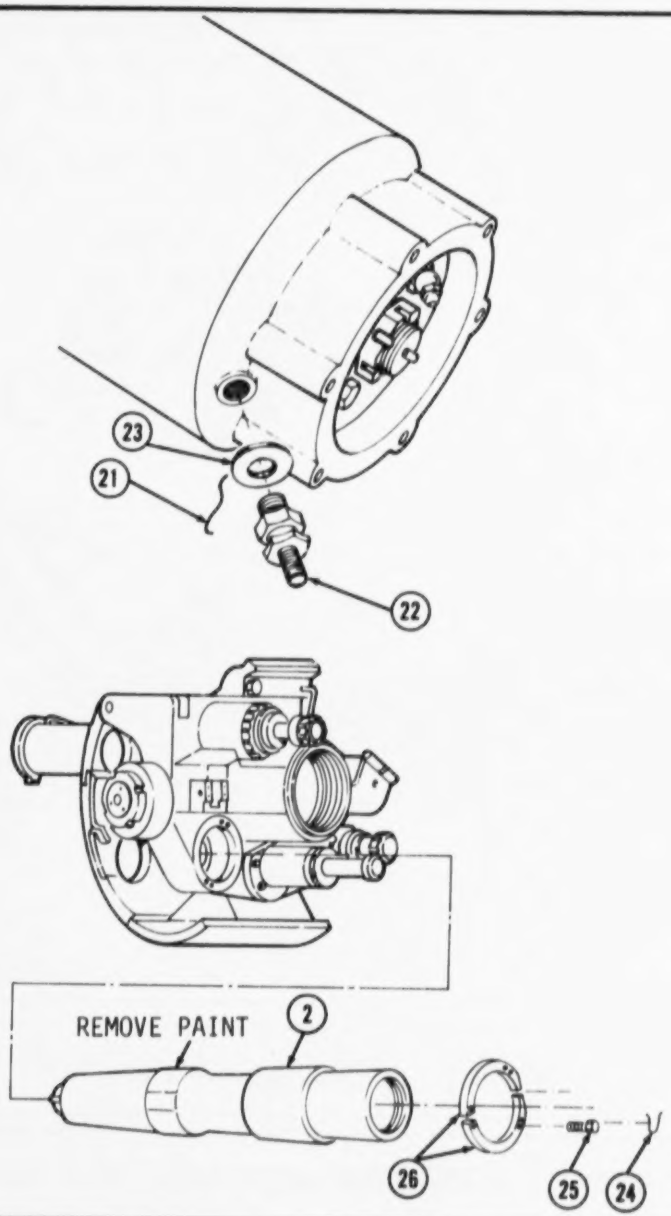
13 Outside soldier must pull the piston group (19) and shouldered shaft (11) forward sufficiently to disengage the other end of the shouldered shaft (11) from the cylinder head group (20) at the rear of the recuperator cylinder (2).

14 Gently push shouldered shaft (11) back into position, locating cylinder head group (20) with end of shouldered shaft (11). Tap cylinder head group (20) out back end of recuperator cylinder (2).

CAUTION

Do not touch shaft with bare hands. Oils on skin will etch polished surface of shaft, allowing rust to form.

15 Wrap shouldered shaft (11) with a rag and remove it from the front end of the recuperator cylinder (2).



16 Remove lock wire (21) from nitrogen valve (22). Remove valve (22) and preformed packing (23). Discard lock wire (21) and preformed packing (23).

WARNING

Block cannon with breech stand (ref. App. E) or chain tube to hull when working on mount components with cannon pushed out of battery. This will prevent serious injury to personnel or damage to equipment caused by accidental elevation of the cannon.

17 Push cannon out of battery 37-1/2 inches (952.5 mm) (ref. TM 9-2350-311-20-2).

18 Retract rammer and swing cylinder down for clearance (ref. TM 9-2350-311-10).

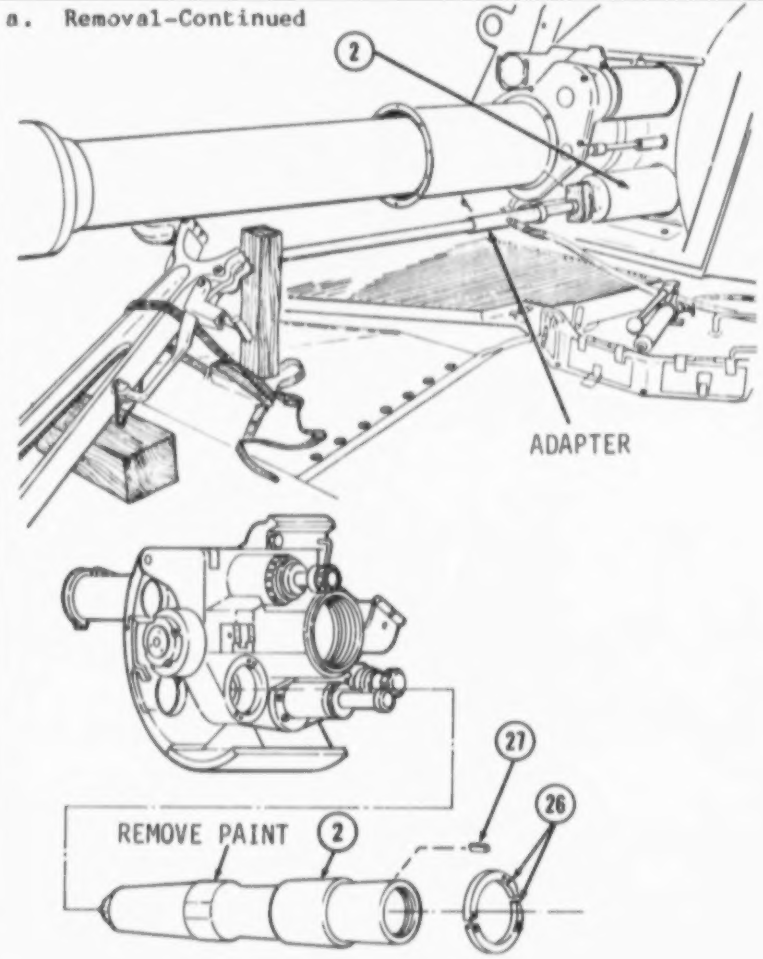
19 Remove paint from front bearing surface of the recuperator cylinder (2).

20 Remove lock wire (24) and six screws (25) from retainer (26). Discard lock wire (24).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

a. Removal-Continued



21 Position hydraulic jack (port-a-power) using appropriate adapters with a 6x4x2 inch block on front face of the recuperator cylinder (2) and suitable blocks on cannon travel lock.

22 Press recuperator cylinder (2) rearward approximately 1/8 inch (3 mm) and remove retainer (26) from groove of recuperator cylinder (2).

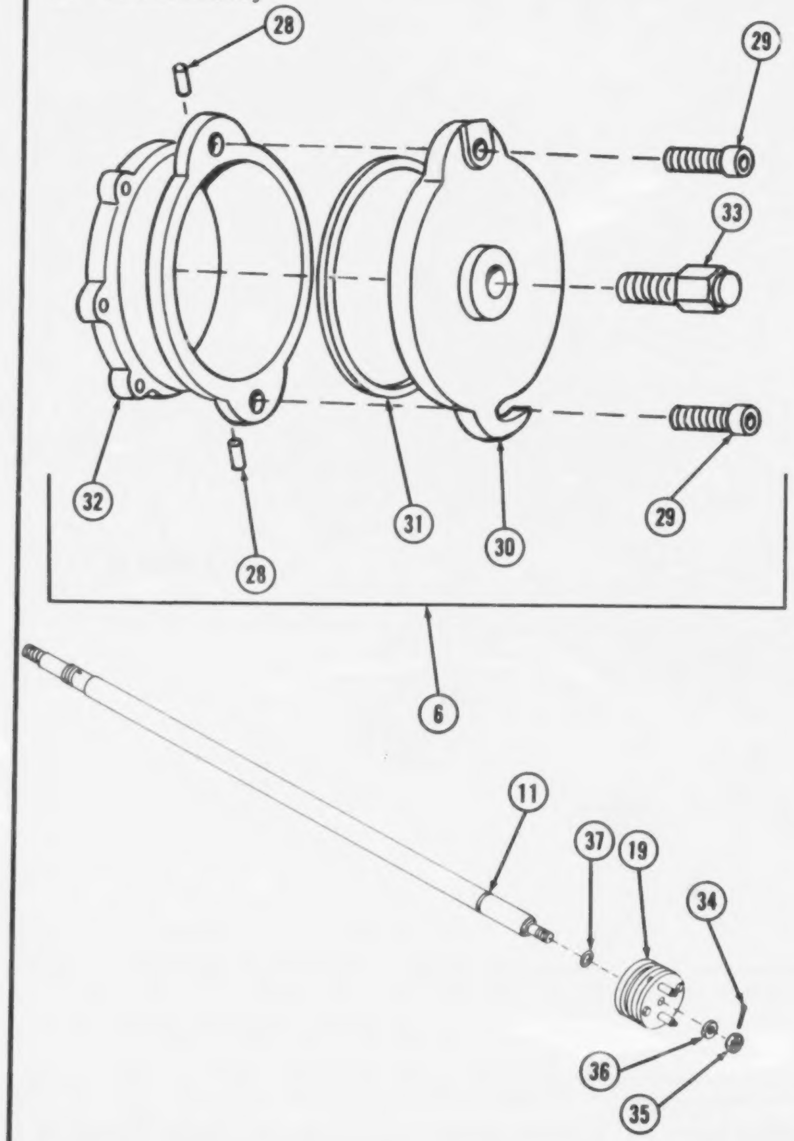
WARNING

Use care while removing recuperator. Cylinder weighs approximaely 177 pounds (80 Kg) and can cause serious injury to personnel or damage to equipment if dropped.

23 Using nylon sling inside of cab to support recuperator cylinder (2), continue to press recuperator cylinder (2) rearward through mount. When recuperator cylinder (2) clears rear of mount, lower to floor and remove through rear door.

24 Remove key (27) from keyway.

b. Disassembly



1 To disassemble cover adapter group (6) remove two spring pins (28) from screws (29). Discard spring pins (28).

2 Remove two screws (29), cover (30) and gasket (31) from cover adapter (32). Discard gasket (31).

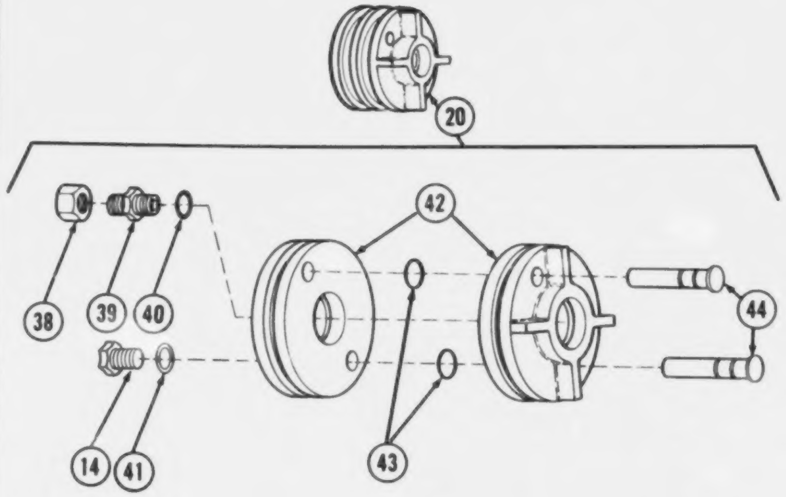
3 Remove safety relief valve (33) from cover (30).

4 Remove cotter pin (34), slotted nut (35), flat washer (36), pistion group (19) and retaining ring (37) from shaft (11). Discard cotter pin (34).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14 RECUPERATOR ASSEMBLY — Continued

b. Disassembly-Continued

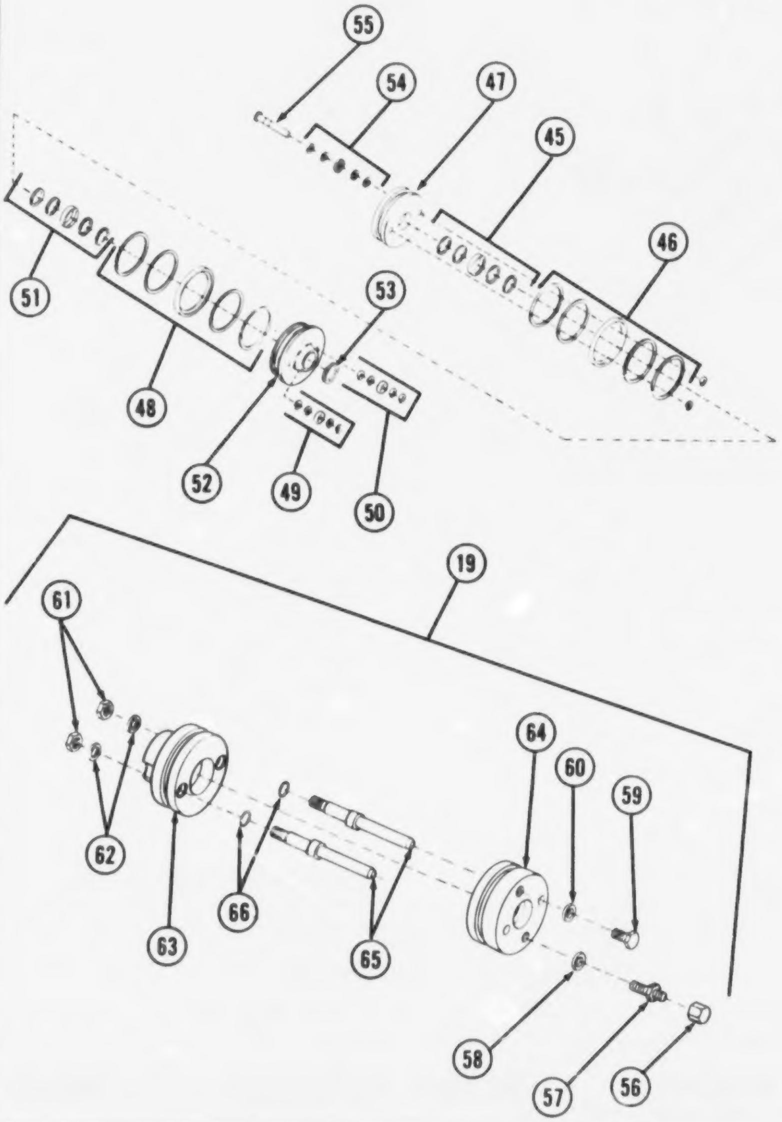


5 To disassemble the cylinder head group (20), remove cap (38), valve (39) and preformed packing (40). Discard preformed packing (40).

6 Remove drain plug (14) and preformed packing (41). Discard preformed packing (41).

7 Separate inner and outer heads (42) and remove two retaining rings (43).

8 Separate pin and seal group (44).



9 Remove seal assemblies (45 and 46) from inner cylinder head (47). Discard seal assemblies (45 and 46).

10 Remove seal assemblies (48, 49, 50 and 51) from outer cylinder head (52). Remove piston wiper (53). Discard seal assemblies (48, 49, 50 and 51) and piston wiper (53).

11 Remove two seal assemblies (54) from two pins (55). Discard seal assemblies (54).

12 To disassemble piston group (19), remove cap (56), valve (57) and preformed packing (58). Discard preformed packing (58).

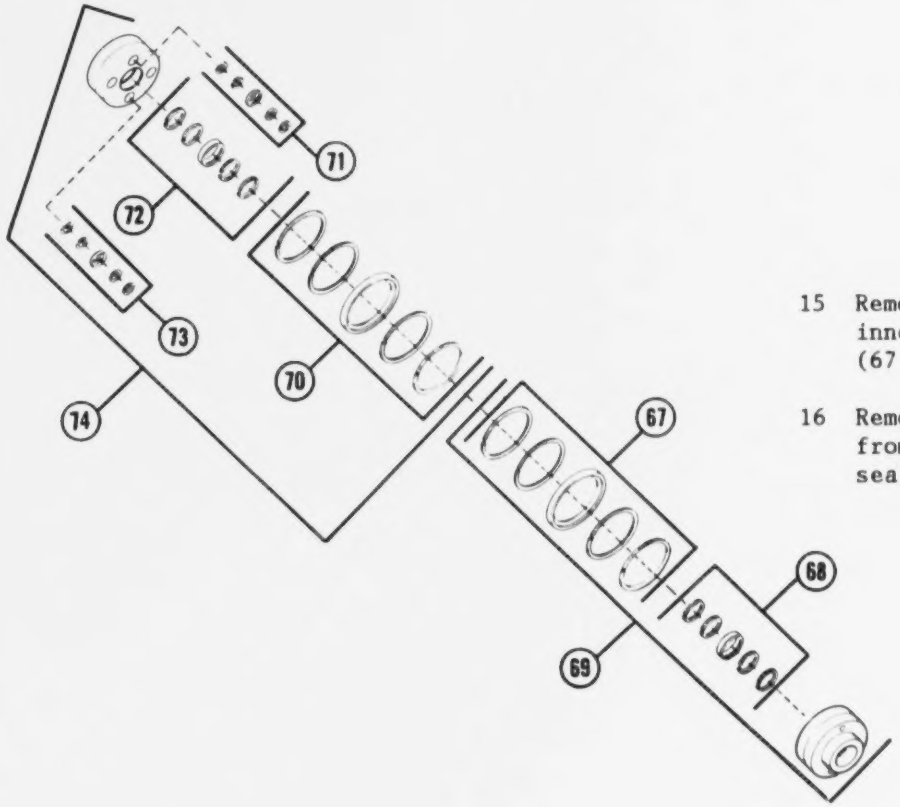
13 Remove plug (59) and preformed packing (60). Discard preformed packing (60).

14 Remove two nuts (61) and two washers (62) and separate the inner piston (63), outer piston (64) and two shafts (65). Remove and discard two preformed packings (66).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

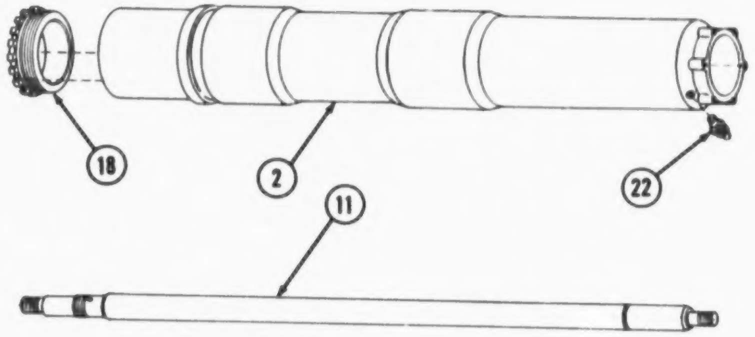
b. Disassembly-Continued



15 Remove seal assemblies (67 and 68) from inner piston asembly (69) and discard seals (67 and 68).

16 Remove seal assemblies (70, 71, 72 and 73) from outer piston assembly (74). Discard seal assemblies (70, 71, 72 and 73).

c. Inspection



1 Inspect retaining ring (18). Replace if cracked, spanner slot shoulders are rounded or if threads are mutilated.

2 Inspect recuperator cylinder (2) for any indication of surface cracks or if bore is scratched, scored or galled. Replace if damaged.

3 Measure recuperator cylinder (2) inside diameter. Replace if greater than 3.877 inches (98.47 mm).

4 Inspect nitrogen valve (22). Replace if damaged in any way that could affect operation.

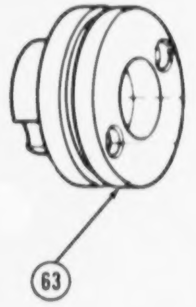
5 Inspect shouldered shaft (11) for nicks, scratches, cracks or mutilation of threads. Replace if damaged.

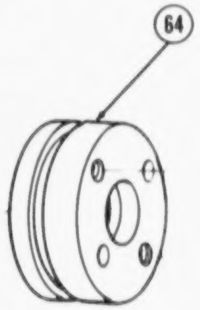
6 Measure shouldered shaft (11) outside diameter. Replace if less than 1.6215 inches (41.18 mm).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

c. Inspection-Continued

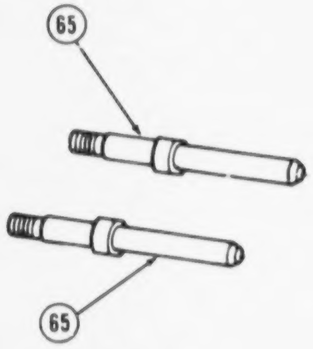




NOTE

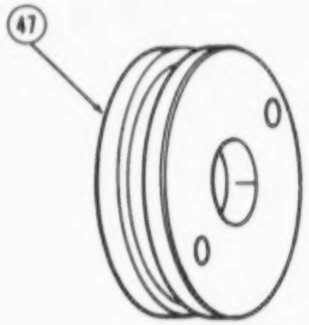
Inner and outer pistons are a matched set. If either component is defective, both must be replaced.

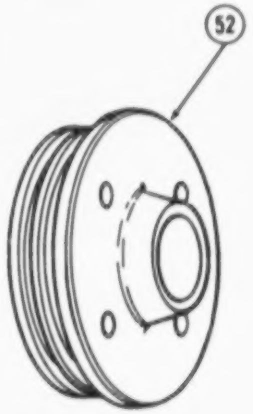
7 Inspect and measure inner piston (63) and outer piston (64). Replace if marked or damaged in any way to affect operation. Replace if outside diameter is less than 3.869 inches (98.27 mm).

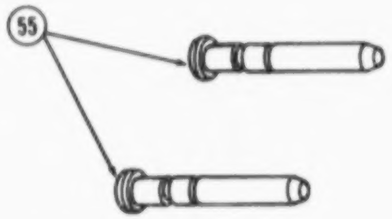


8 Inspect two shafts (65) for straightness, nicks, cracks or burrs. Replace if damaged.

9 Measure two shafts (65). Replace if outside diameter is less than 0.499 inches (12.67 mm).







NOTE

Inner and outer cylinder heads are a matched set. If either component is defective, both must be replaced.

10 Inspect inner and outer cylinder heads (47 and 52). Replace if cracked, nicked or damaged in any way affecting operation.

11 Measure inner and outer cylinder heads (47 and 52). Replace if outside diameter is less than 5.740 inches (145.79 mm).

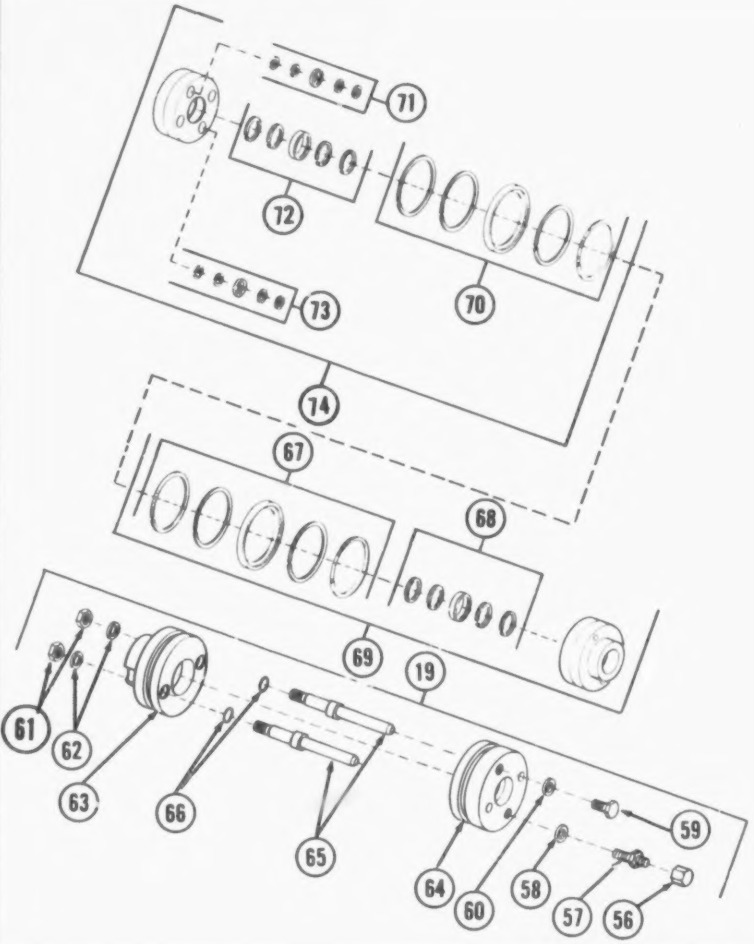
12 Inspect two pins (55) and replace if not straight or if nicked, cracked or burred.

13 Measure two pins (55). Replace if outside diameter is less than 0.499 inches (12.67 mm).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

d. Assembly



CAUTION

During assembly and installation of recuperator, use extreme care to prevent contamination.

NOTE

Coat all packings, seals, pistons and cylinder head groups with hydraulic fluid (Item 10, app. C) before installation.

1 Install new seal assemblies (73, 72, 71 and 70) on outer piston assembly (74).

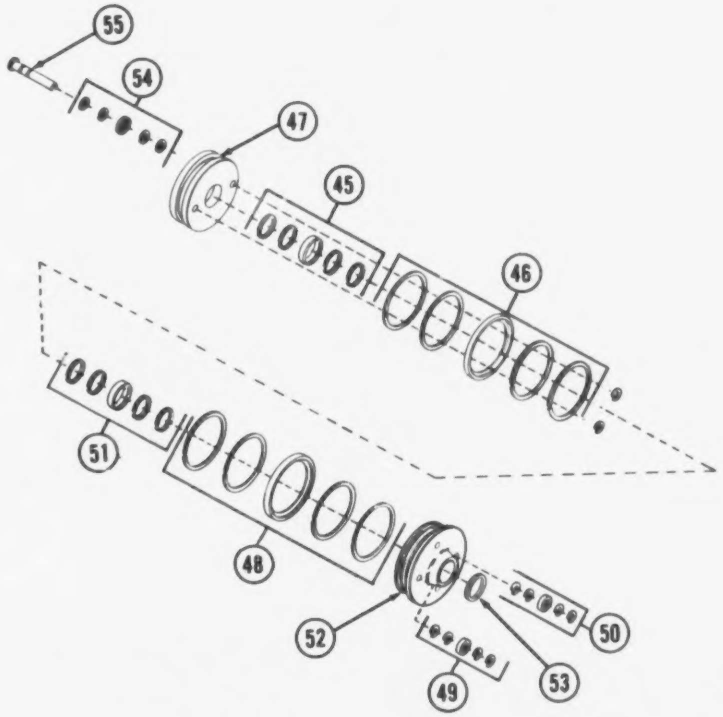
2 Install new seal assemblies (68 and 67) on inner piston assembly (69).

3 Assemble piston group (19) by installing two new preformed packings (66) and two shafts (65). Assemble outer piston (64) and inner piston (63) with "X" marks coinciding.

4 Install two washers (62) and two nuts (61).

5 Install new preformed packing (60) and plug (59).

6 Install new preformed packing (58) and valve (57). Torque valve to a maximum of 120 in-lb (13.45 N·m) and install cap (56).



7 Install two new seal assemblies (54) on two pins (55).

8 Split new piston wiper (53) diagonally 3/4 inches (19.05 mm) front to rear and cement in place on outer cylinder head (52) using adhesive (Item 1, App. C).

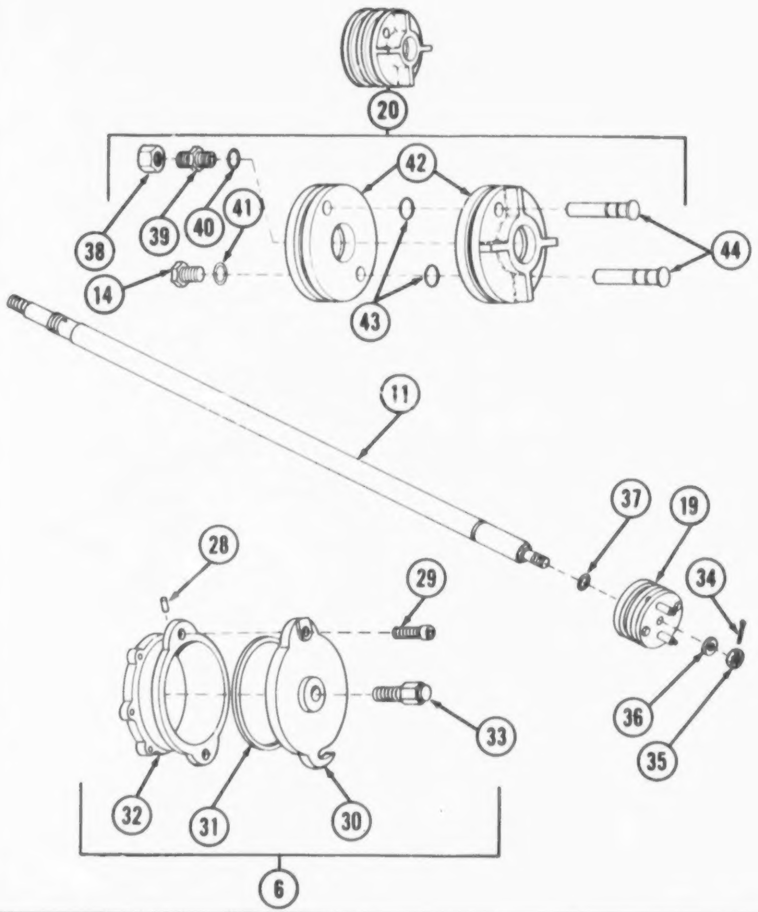
9 Install new seal assemblies (51, 50, 49 and 48) on outer cylinder head (52).

10 Install new seal assemblies (46 and 45) on inner cylinder head (47).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY – Continued

d. Assembly-Continued



11 To assemble the cylinder head group (20), install the pin and seal group (44) in the inner cylinder head (47) (ref. page 4-161).

12 Install two retaining rings (43) and assemble inner and outer heads (42).

13 Install new preformed packing (41) and drain plug (14).

14 Install new preformed packing (40) and valve (39). Torque valve to 120 in-lb (13.45 N.m) maximum and install cap (38).

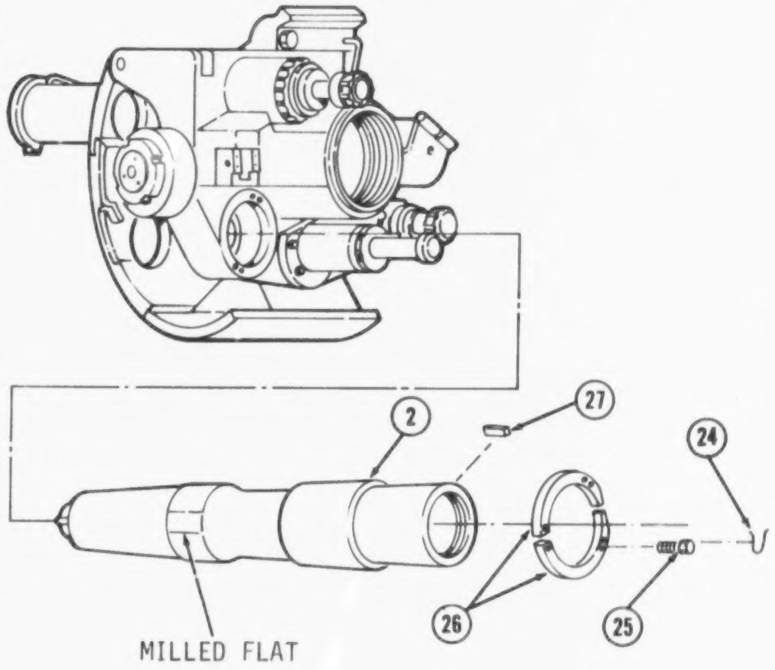
15 Install retaining ring (37), piston group (19), flat washer (36), slotted nut (35) and new cotter pin (34) on shouldered shaft (11).

16 Assemble cover adapter group (6) by installing safety relief valve (33).

17 Install new gasket (31), cover (30) and two screws (29) on cover adapter (32).

18 Install two new spring pins (28).

e. Installation



CAUTION

Use extreme care when installing recuperator and components to prevent contamination.

1 Clean the two large diameters of the recuperator cylinder (2) removing all paint, nicks, scratches and gouges. Coat two diameters with grease (Item 9, App. C).

2 Remove all paint, nicks, scratches and gouges from the M178 mount at the bearing surface for the recuperator cylinder (2).

3 Install key (27) in keyway.

WARNING

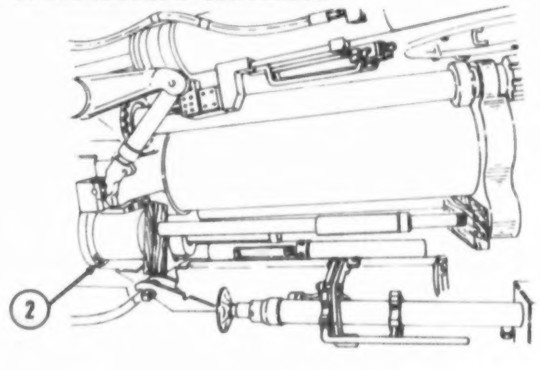
Use care while installing the recuperator cylinder. Cylinder weighs approximately 177 pounds (80 Kg) and can cause serious injury to personnel or damage to equipment if dropped.

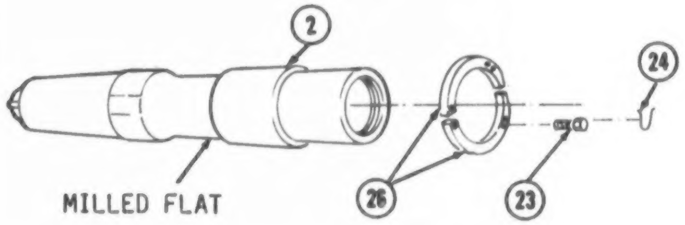
4 Using nylon sling inside cab to support recuperator cylinder (2), position milled flat on left side of recuperator cylinder (2) and slide forward until bearing surfaces meet.

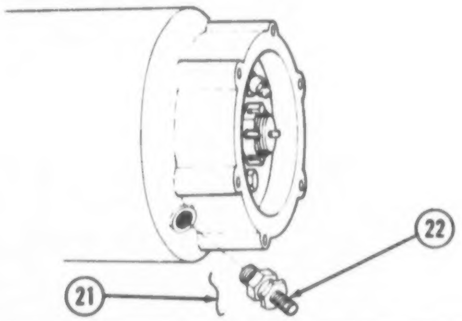
MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

e. Installation-Continued







NOTE

Do not press cylinder all the way into mount. Stop approximately 1/8 inch (3 mm) short of retainer groove.

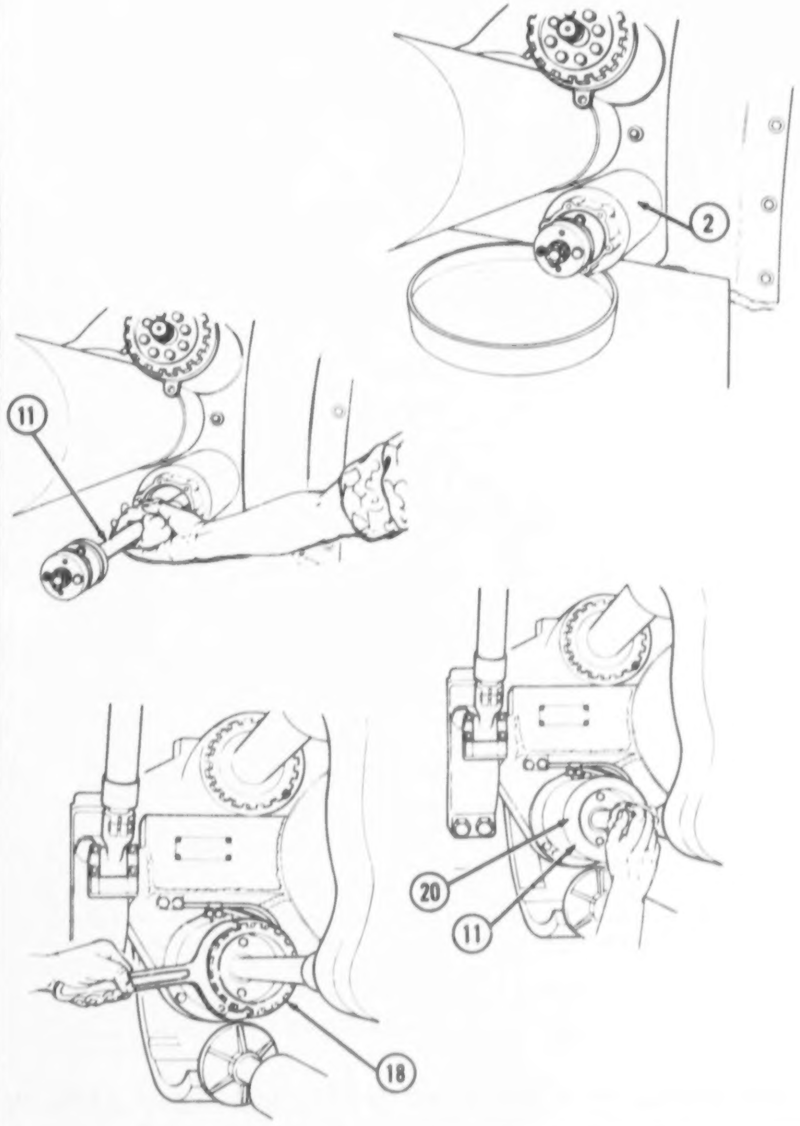
5 Position hydraulic jack (port-a-power) between blocks of wood against breech ring of cannon assembly and rear face of recuperator cylinder (2). Press recuperator cylinder (2) to approximately 1/8 inch (3 mm) short of retainer (26) groove.

6 Position retainer (26) in groove and aline screw holes. Press recuperator cylinder (2) until retainer (26) rings contact mount.

7 Remove hydraulic jack (port-a power) and install six screws (23) and new lock wire (24).

8 Return weapon-mounted rammer to stowed position (ref. TM 9-2350-311-10).

9 Install nitrogen valve (22) and torque to a maximum of 120 in-lb (13.56 N'm). Install new lock wire (21).



CAUTION

Do not touch shaft with bare hands. Oils on skin will etch polished surface of shaft, allowing rust to form.

10 Wrap shouldered shaft (11) with clean rag and gently insert into recuperator cylinder (2) from the outside. Slowly push forward until inside end extends from recuperator cylinder (2) slightly.

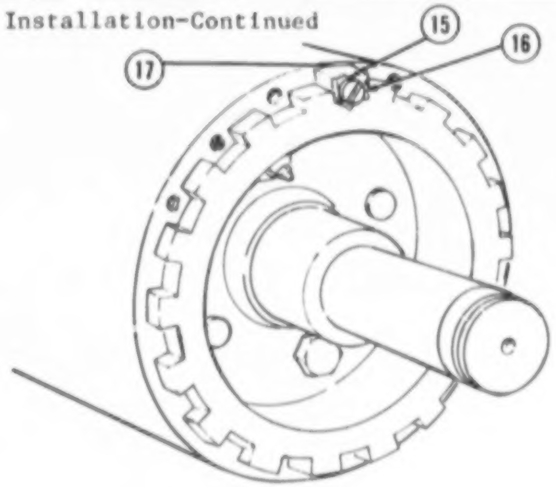
11 Locate inside end of shouldered shaft (11) in the cylinder head group (20) and gently tap cylinder head group (20) into end of recuperator cylinder (2).

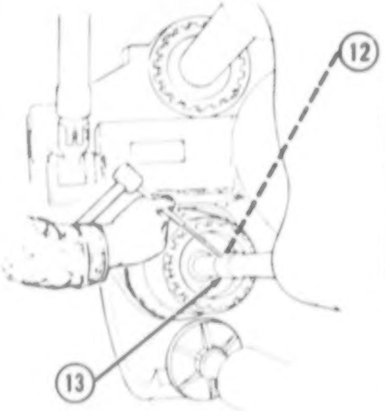
12 Install retaining ring (18) and tighten, using suitable spanner wrench.

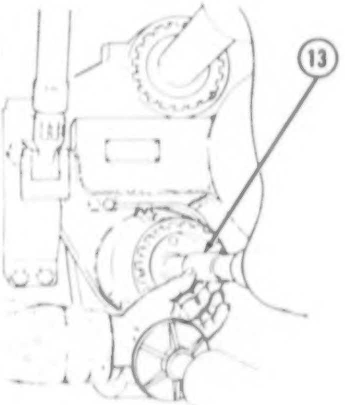
MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

e. Installation-Continued



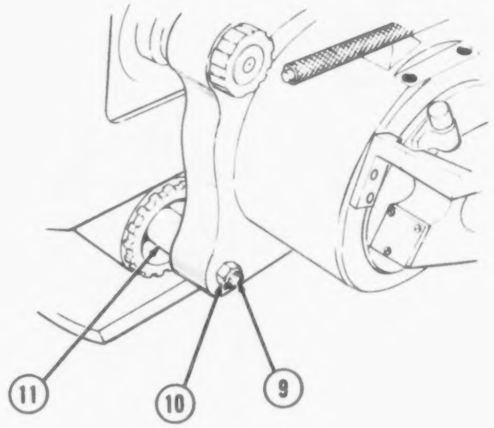


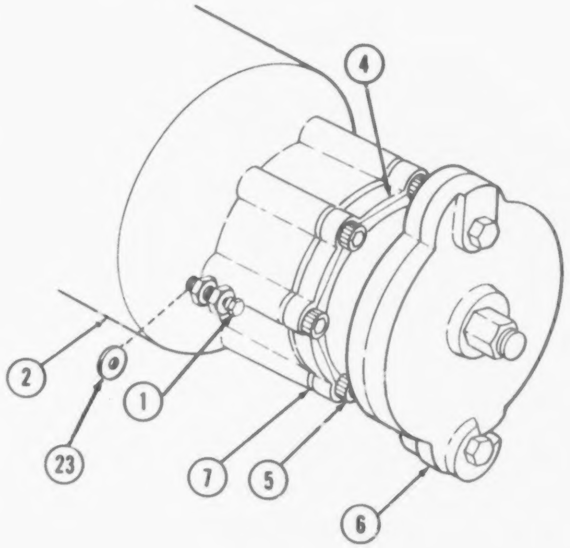


13 Install key (17), screw (16) and new lock wire (15).

14 Install shaft collar (13) and new spring pin (12).

15 Return cannon to battery (ref. TM 9-2350-311-20-2).





16 Install rear slotted nut (10) and new cotter pin (9) on shouldered shaft (11).

17 Install new gasket (7), cover adapter group (6), six screws (5) and new lock wire (4) on front of recuperator cylinder (2).

18 Install nitrogen valve (22) with new preformed packing (23). Torque valve to 120 in-lbs.

19 Service recuperator with hydraulic fluid (Item 10, App. C) (ref. page 4-168).

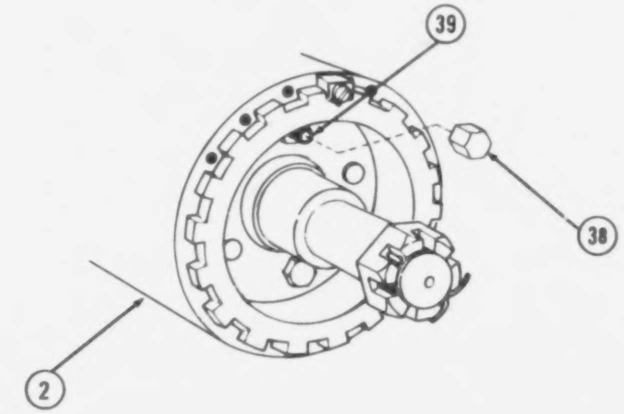
20 Service recuperator with nitrogen (Item 18, App. C) (ref. page 4-170).

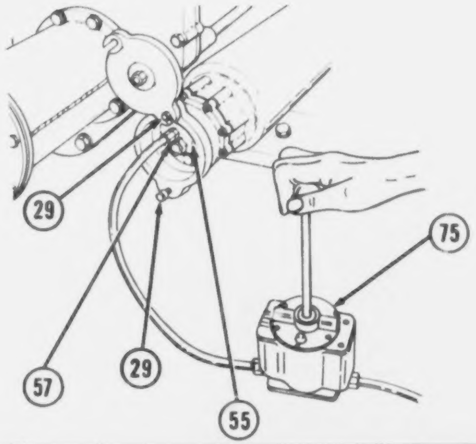
21 Install nitrogen valve cap (1) to right front of recuperator cylinder (2).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

f. Servicing with Hydraulic Fluid





1 Remove cap (38) from valve (39) at head end of recuperator cylinder (2), inside cab.

CAUTION

Hydaulic fluid must be new. Recuperator must be free of contaminating matter.

NOTE

Rotate head to position drain plug at bottom.

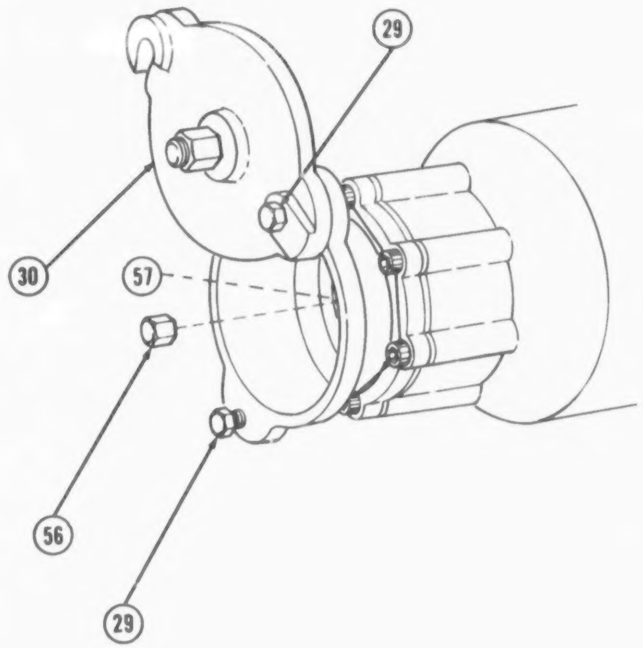
2 Attach M3 oil pump (75) to valve (39). Fill head until two pins (55) extend not less than 1/8 inch (3 mm). Do not overfill (head requires about 0.7 pint (0.3 l)). After filling, disconnect M3 oil pump (75).

3 Install cap (38).

CAUTION

Loosen screws to stop pin before rotating cover to prevent damage to gasket.

4 Loosen two screws (29) at front end of recuperator cylinder (2).



5 Rotate cover (30) to the open position (ref. page 4-168).

6 Remove cap (56) from valve (57).

7 Attach M3 oil pump (75) to valve (57). Fill piston until two pins (55) extend not less than 1/8 inch (3 mm). Do not overfill (piston requires about 0.5 pint (0.2 l)). After filling, disconnect M3 oil pump (75).

8 Install cap (56).

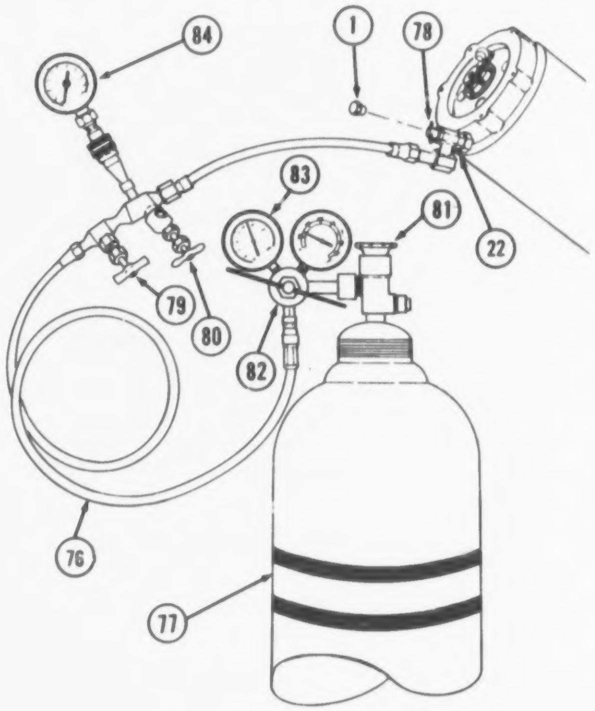
9 Rotate cover (30) to the closed position.

10 Tighten two screws (29).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY – Continued

g. Servicing with High Pressure Nitrogen-Method One



WARNING

Dry nitrogen tanks are marked with one or two black bands at the top of the tank. Do not use tanks without black band. In charging recuperator, use dry nitrogen. Certain other gases will cause recuperator cylinder to explode, resulting in possible death or serious injury.

CAUTION

Open and close nitrogen cylinder shut off valve to clear valve seat of any dust or dirt. Repeat operation after installation of pressure regulator to clear hose.

NOTE

Recuperator must be serviced with hydraulic fluid (Item 10, App. C) before it is charged with dry nitrogen.

1 Attach nitrogen charging kit (76) (Item 11, App. B) to nitrogen cylinder (77) as shown.

2 Remove nitrogen valve cap (1). Attach valve (78) of nitrogen charging kit (76) to nitrogen valve (22) but do not tighten valve (78).

3 Close valves (79 and 80) of nitrogen charging kit (76).

4 Open nitrogen cylinder (77) shutoff valve (81).

5 Open pressure regulator valve (82) slowly until 3000 psi gage (83) shows 15-20 psi (103-139 kPa), then close pressure regulator valve (82).

6 Open valves (79) on nitrogen charging kit (76). Tighten valve (78) just before gage (83) registers 0 psi (0 kPa).

NOTE

Gage (84) must be at least a 1000 psi gage.

7 Open nitrogen valve (22) and observe pressure on gage (84). Pressure should read 700 ±50 psi (4826 ±345 kPa) at 70°F (21°C). If not, go to step 8.

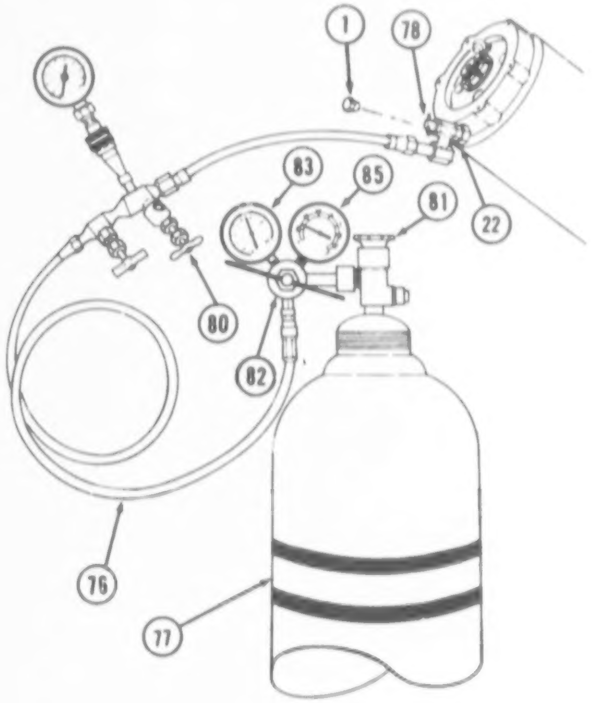
NOTE

If recuperator cylinder is charged to 700 ±50 psi (4826 ±345 kPa), go to step 11.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

g. Servicing with High Pressure Nitrogen (Method One)-Continued



8 Open nitrogen cylinder (77) shutoff valve (81). Observe nitrogen cylinder (77) pressure gage (85). Pressure should be at least 800 ±50 psi (5516 ±345 kPa).

9 Open pressure regulator valve (82) until gage (83) registers 700 ±50 psi (4826 ±345 kPa) at 70°F (21°C).

10 Loosen nut on nitrogen valve (22) about 1 turn (2-1/4 turns provide maximum opening).

CAUTION

Charging the system too fast will heat the dry nitrogen. This will give an inaccurate reading because the pressure will decrease when the nitrogen cools, possibly causing equipment to malfunction.

NOTE

Estimated time to charge system is 30 minutes. System should be charged at ambient temperature of weapon use.

11 Tighten nut on nitrogen valve (22) when sound of nitrogen flow has stopped.

12 Close nitrogen cylinder (77) shutoff valve (81).

13 Open valve (80) on nitrogen charging kit (76). Slowly relieve pressure in nitrogen charging kit (76). Remove valve (78) from nitrogen valve (22).

14 Install nitrogen valve cap (1) on nitrogen valve (22).

15 Close pressure regulator valve (82).

16 Remove nitrogen charging kit (76) from nitrogen cylinder (77).

h. Servicing with High Pressure Nitrogen (Method Two)

NOTE

Recuperator must be serviced with hydraulic fluid (Item 10, App. C) before it is charged with dry nitrogen.

1 Connect and tighten nitrogen charging kit (76) to nitrogen cylinder (77) as shown.

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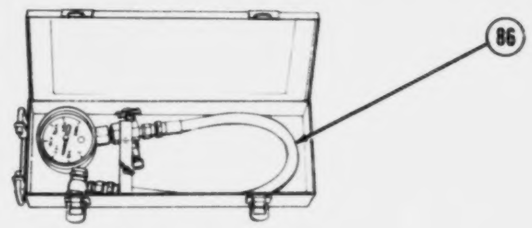
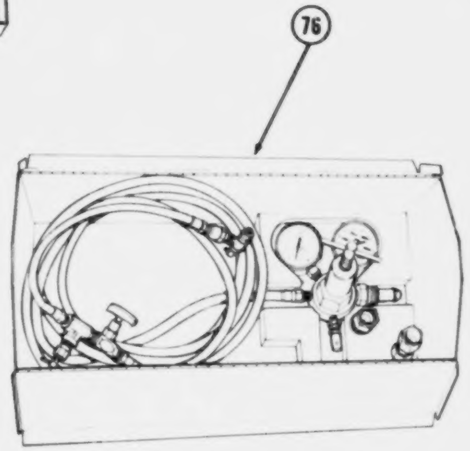
MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

h. Servicing with High Pressure Nitrogen-Method Two-Continued



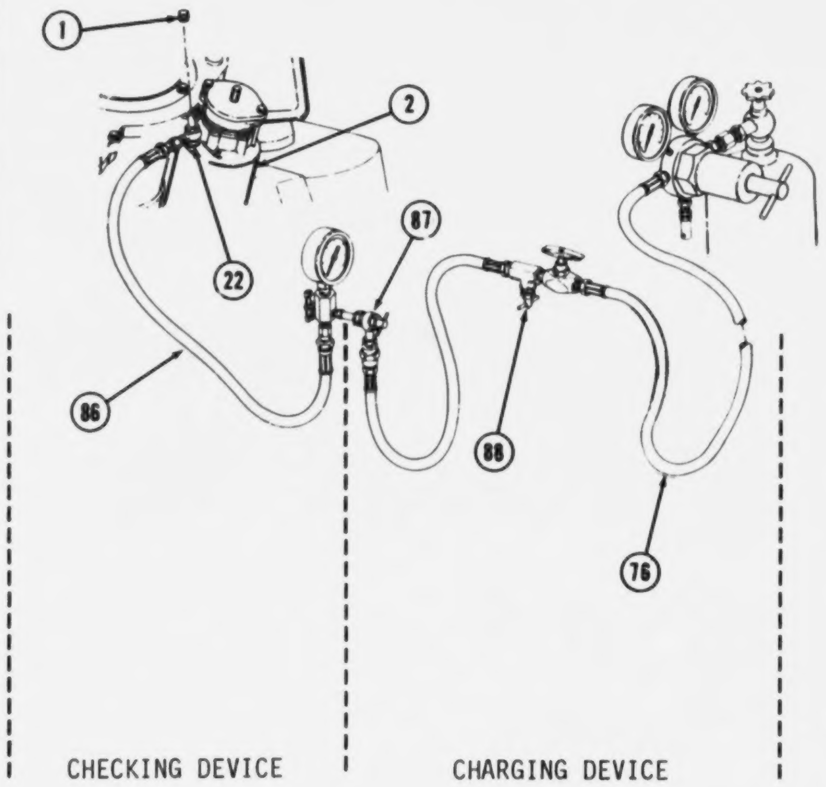


WARNING

Dry nitrogen tanks are marked with one or two black bands at the top of the tank. Do not use tanks without black band. In charging recuperator cylinder, use dry nitrogen. Certain other gases will cause recuperator cylinder to explode, resulting in possible death or serious injury.

CAUTION

Open and close nitrogen cylinder shutoff valve to clear valve seat of any dust or dirt. Repeat operation after installation of pressure regulator to clear hose.


1
2
87
22
86
88
76
CHECKING DEVICE
CHARGING DEVICE

CAUTION

Cannon is shown elevated only for clarification. Cannon must be at zero elevation when checking or charging recuperator cylinder.

2 Remove nitrogen valve cap (1) from nitrogen valve (22).

3 Connect nitrogen checking kit (86) (Item 11, App. B) to nitrogen valve (22) on recuperator cylinder (2).

4 Connect nitrogen charging kit (76) (Item 11, App. B) to nitrogen checking device (86) as shown.

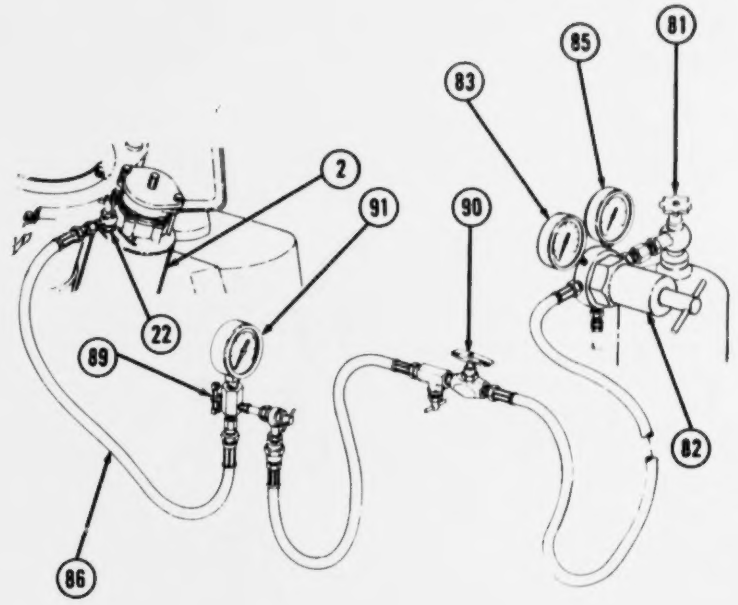
5 Open valve (87).

6 Close valve (88).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY – Continued

h. Servicing with High Pressure Nitrogen (Method Two)-Continued



7 Close bleeder valve (89).

8 Open introgen valve (22) by turning counterclockwise.

9 Close pressure regulator valve (82), turning counterclockwise until no spring pressure is felt.

10 Open nitrogen cylinder shutoff valve (81) slowly until full cylinder pressure is indicated on pressure gage (85).

11 Open pressure regulator valve (82) slowly, turning clockwise until pressure on 3000 psi gage (83) registers 50 psi (345 kPa).

12 Open valve (90), allowing nitrogen to enter the recuperator cylinder assembly until gage (91) on the nitrogen checking device (86) reads 50 psi (345 kPa). Close valve (90).

CAUTION

Charging the system too fast will heat the dry nitrogen. This will give an inaccurate reading because the pressure will decrease when the nitrogen cools, possibly causing equipment to malfunction.

NOTE

Estimated time to charge system is 30 minutes. System should be charged at ambient temperature of weapon use.

13 Open bleeder valve (89) until all nitrogen is bled from recuperator cylinder (2); then close bleeder valve (89).

14 Repeat steps 12 and 13 to remove all traces of moisture prior to charging system to full pressure with nitrogen.

15 Open pressure regulator valve (82) slowly, turning clockwise until pressure on 3000 psi gage (83) registers 100 psi (690 kPa) at 70°F (21°C).

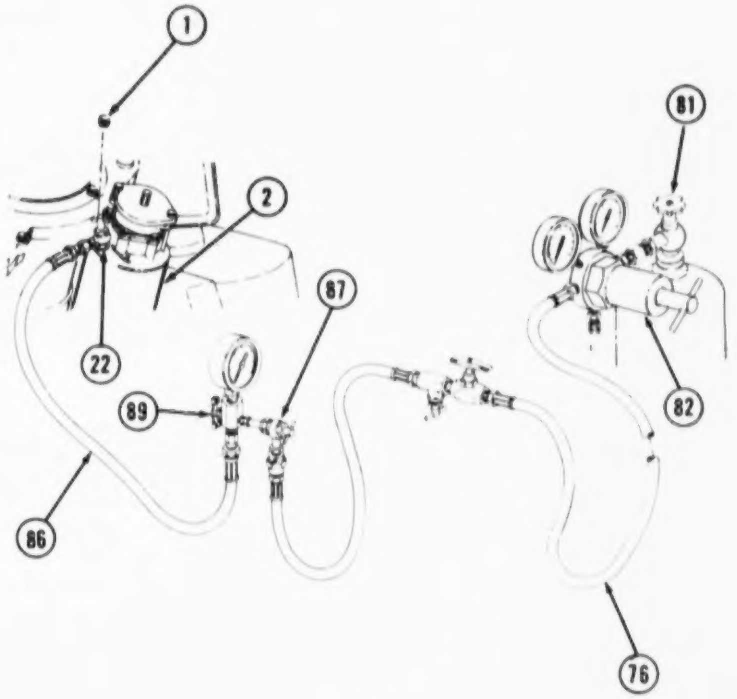
16 Open valve (90) slowly, allowing introgen to charge recuperator.

17 Open pressure regulator valve (82) to raise pressure at 100 psi (690 kPa) increments until gage (91) stabilizes at 750 psi (5171 kPa) at 70°F (21°C).

MOUNT AND HCWITZER ASSEMBLY — Continued

4-14. RECUPERATOR ASSEMBLY — Continued

h. Servicing with High Pressure Nitrogen (Method Two)-Continued



WARNING

Failure to close nitrogen valve on recuperator cylinder could result in injury to personnel from high pressure gas.

18 Close nitrogen valve (22) and nitrogen cylinder shutoff valve (81). Let system set for one hour after charging. Charging device (76) and nitrogen cylinder can be disconnected from nitrogen checking device (86).

WARNING

Failure to open bleeder valve could result in injury.

19 Open bleeder valve (89) to bleed pressure from nitrogen charging kit (76) and nitrogen checking device (86).

20 Disconnect nitrogen charging kit (76) and nitrogen checking device (86) at valve (87).

21 Close pressure regulator valve (82) by turning counterclockwise.

22 Disconnect nitrogen charging kit (76) from nitrogen cylinder (77) shutoff valve (81).

23 After one hour wait, close bleeder valve (89).

24 Slowly open nitrogen valve (22). Read pressure gage to determine if leakage has occurred. If no leakage is detected, slowly open valve (89), releasing pressure in recuperator cylinder (2) to 700 psi (4826 kPa).

25 Close nitrogen valve (22).

26 Slowly open bleeder valve (89).

27 Disconnect nitrogen checking device (86) from nitrogen valve (22) on recuperator cylinder (2).

28 Apply soap suds to nitrogen valve (22) to determine if any nitrogen leaks. If leaks occur, tighten nitrogen valve (22). If leaks are still present, release nitrogen pressure and replace defective valve (22).

29 If no leaks are present, replace nitrogen valve cap (1).

30 Apply soap suds to both ends of recuperator cylinder (2) to determine if nitrogen leaks. If leaks are present, repair recuperator cylinder (2) (ref. page 4-146).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15 VARIABLE RECOIL ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts	Personnel Required	Test Equipment	Special Tools
Gaskets	3	Calipers	Spanner wrench
Flat washers		Micrometers, inside and outside	
Lock washers			
Lock wire			
Seal replacement kits P/N 5910844			
Hydraulic fluid (Item 10, App. C)			
High pressure dry nitrogen (Item 18, App. C)			
Spring pins			
Locknuts			

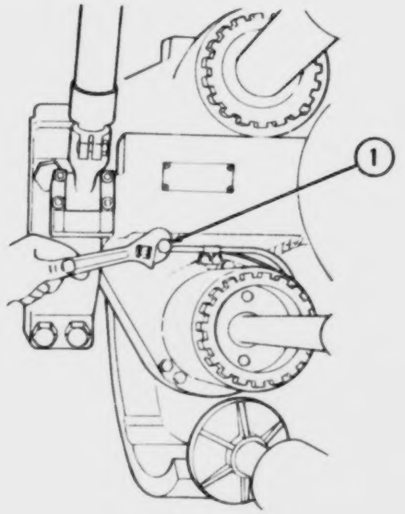
a. Removal

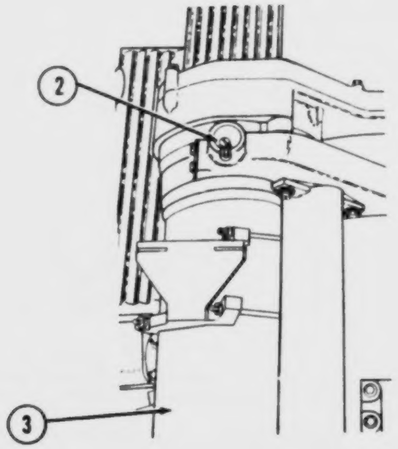
WARNING

Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.

NOTE

Variable recoil assembly can be disassembled and repaired with mount and cannon installed in vehicle.





1 Stow travel lock (ref. TM 9-2350-311-10).

2 Remove muzzle brake (ref. page 4-72).

3 Remove evacuator (ref. page 4-76).

4 Remove dust shield (ref. page 4-94).

5 Depress cannon to 0 mils.

6 Cover engine grille with tarpaulin (ref. TM 9-2350-311-10).

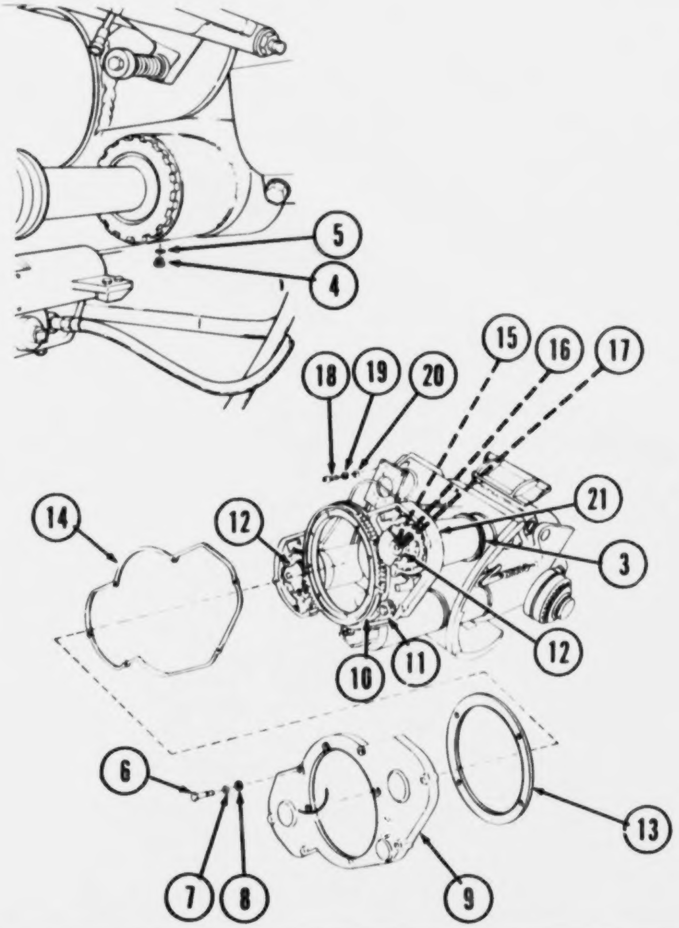
7 Open accumulator replenisher right manifold bleeder plug (1) and discharge hydraulic pressure by draining fluid into container.

8 Open bleeder "T" (2) at front of left recoil cylinder (3).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

a. Removal-Continued



9 Remove two recoil cylinder drain plugs (4) and two preformed packings (5) at rear of each recoil cylinder (3). Discard two preformed packings (5).

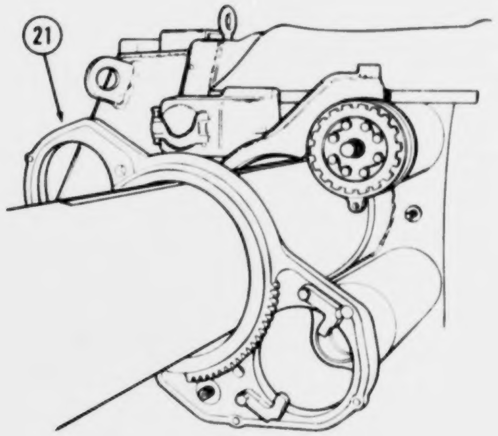
10 Drain system and catch fluid using trough and container.

11 Remove six bolts (6), six lock washers (7) and six flat washers (8) from variable recoil housing cover (9). Discard six lock washers (7).

12 Measure backlash between segment gear (10), spur gear (11) and two sector gears (12) before removal.

- a Measure backlash between one sector gear (12) and segment gear (10). Replace if greater than 0.018 inches (.45 mm).
- b Measure backlash between spur gear (11) and segment gear (10). Replace if greater than 0.018 inches (.45 mm).
- c Measure backlash between other sector gear (12) and segment gear (10) and replace if greater than 0.018 inches (.45 mm).

13 Slide variable recoil housing cover (9) and gaskets (13 and 14) forward along cannon tube and remove from end. Discard gaskets (13 and 14).



NOTE

Note alinement of index arrows on segment gear, spur gear and sector gears before removing housing group.

14 Remove two screws (15), two lock washers (16), two flat washers (17) and two sector gears (12). Discard lock washers (16).

15 Remove four screws (18), four lock washers (19) and four flat washers (20) from variable recoil housing (21). Discard lock washers (19).

16 Slide variable recoil housing (21) forward along cannon tube and remove.

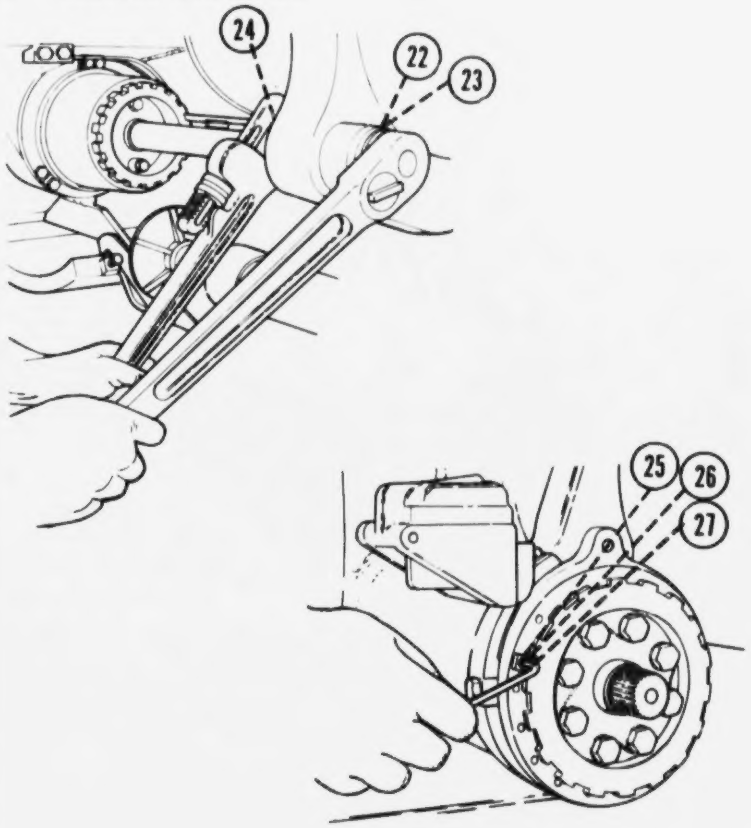
WARNING

- Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.
- Level cannon before venting nitrogen to avoid serious injury to personnel or damage to equipment caused by cannon sliding out of battery.
- Keep all parts of body clear to prevent serious injury when venting nitrogen. High pressure nitrogen must be completely vented to prevent injury to personnel.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

a. Removal-Continued



17 Release nitrogen from recuperator (ref. page 4-170).

18 While holding collar (24) with pipe wrench remove cotter pin (22) and rear nut (23) from recuperator assembly. Discard cotter pin (22).

19 Push cannon cut of battery 18 inches (457 mm) (ref. TM 9-2350-311-20-2).

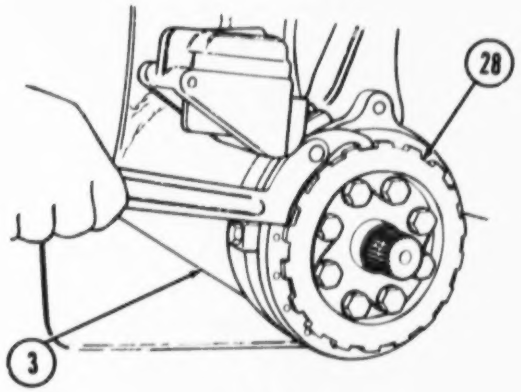
WARNING

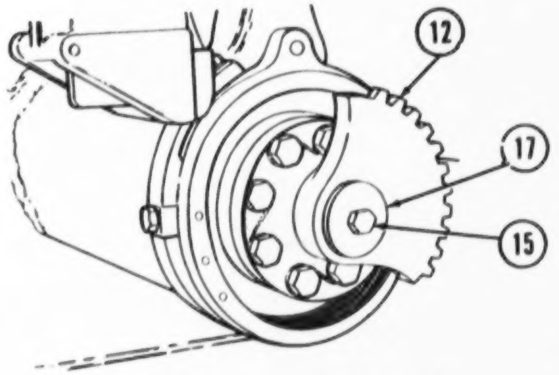
Block cannon with breech stand (ref. App.E) or chain tube to hull when working on mount components with cannon pushed out of battery. This will prevent serious injury to personnel or damage to equipment caused by accidental elevation of the cannon.

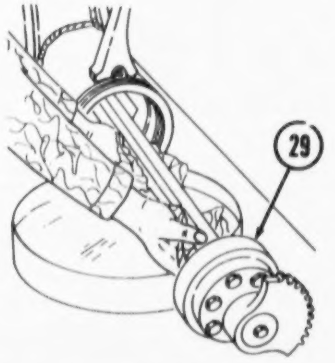
NOTE

Both recoil cylinders are identical. Removal instructions pertain to one. Repeat instructions for remaining cylinder.

20 Remove lock wire (25), bolt (26) and key (27) from front of recoil cylinder (3).







21 Remove machine bushing (28) from front of recoil cylinder (3) using spanner wrench.

22 Install sector gear (12), flat washer (17) and screw (15) to provide leverage.

WARNING

Use gloves or rags to grip inner orifice. Edge of orifice is extremely sharp and could cause injury.

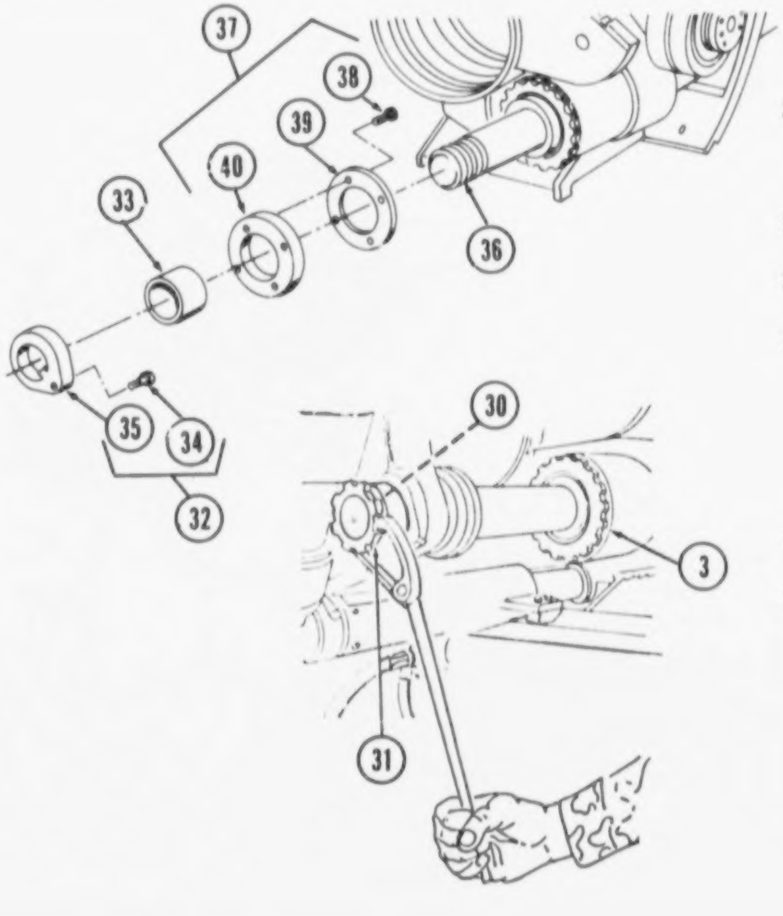
23 Using a prybar, pry inner orifice and front follower group (29) out of recoil cylinder (3). Place a shallow receptacle under recoil cylinder (3) to catch fluid while withdrawing inner orifice and front follower group (29).

24 Remove screw (15), flat washer (17) and sector gear (12) from inner orifice and front follower group (29).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY – Continued

a. Removal-Continued



25 Bend tab of key washer (30) to disengage it from slot in nut (31) at rear of recoil cylinder (3).

26 Remove nut (31) using spanner wrench.

27 Remove key washer (30).

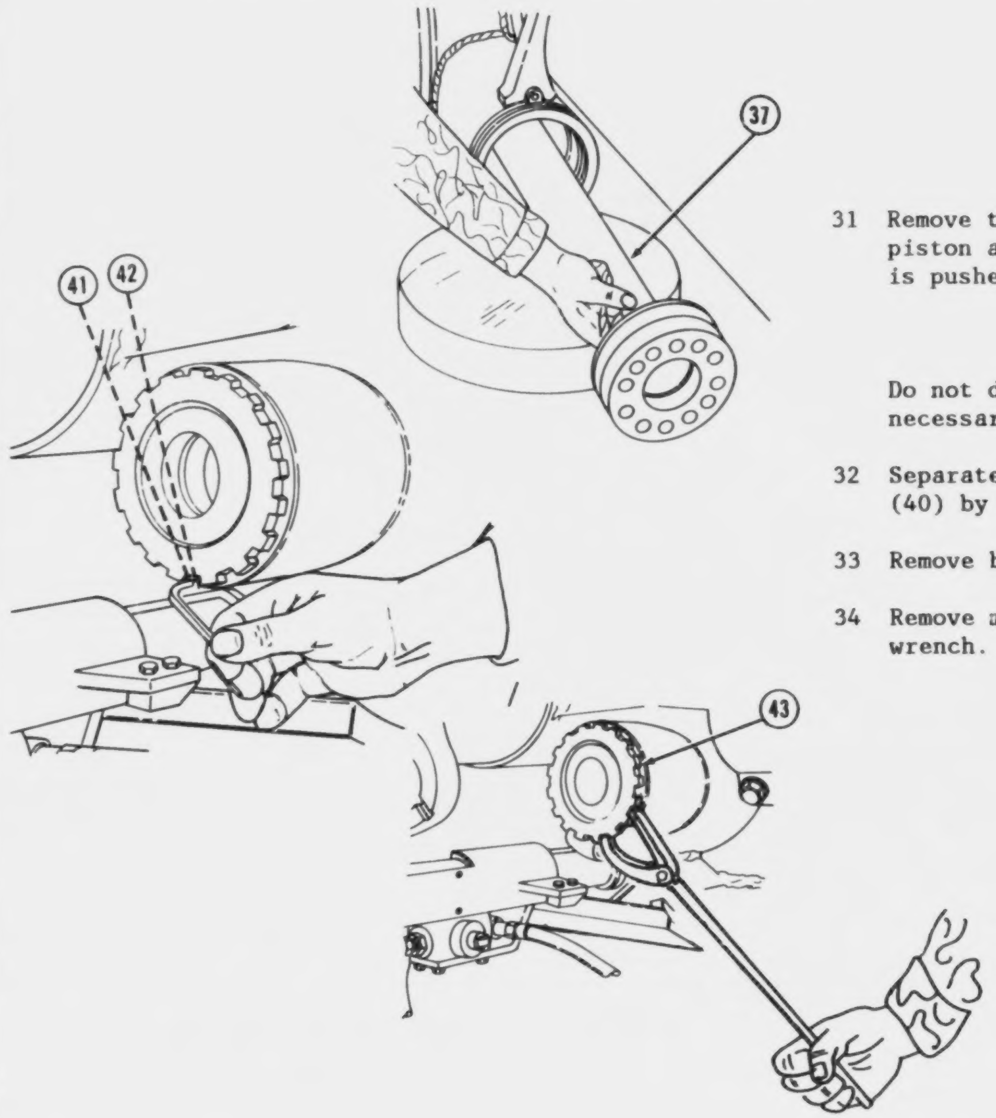
28 Remove key assembly (32) and spacer (33).

NOTE

Do not disassemble key unless repair is required.

29 Remove pin (34) from key (35).

30 Move piston assembly (36) forward to prepare for removal out the front of the recoil cylinder (4), but do not remove at this time.



31 Remove thrust plate group (37) from rear of piston assembly (36) as piston assembly (36) is pushed into recoil cylinder (3).

NOTE

Do not disassemble unless repair is necessary.

32 Separate plate spacer (39) and thrust plate (40) by removing four screws (38).

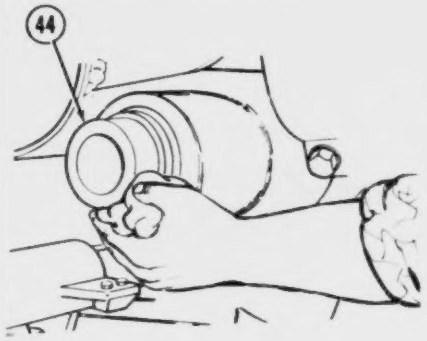
33 Remove bolt (41) and key (42).

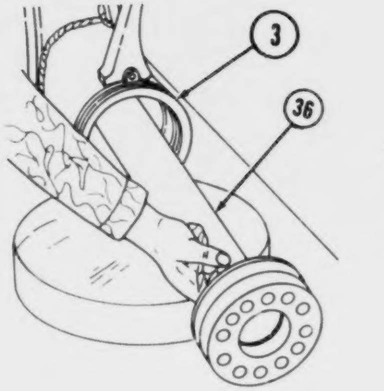
34 Remove machine bushing (43) using spanner wrench.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

a. Removal-Continued



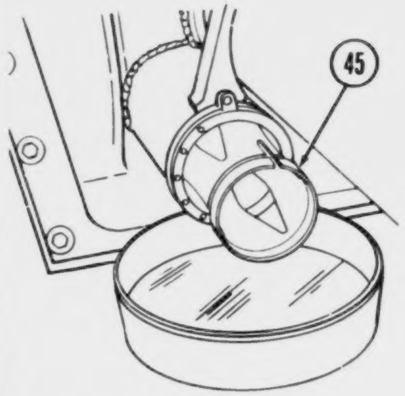


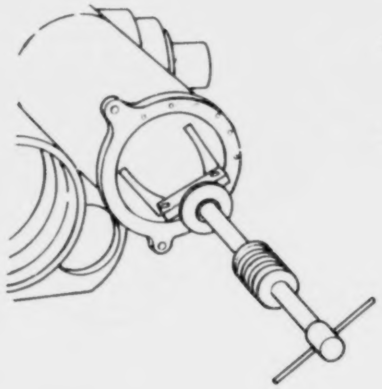
35 Use piston rod to tap gently on rear follower group (44).

36 Remove rear follower group (44) from rear of recoil cylinder (3).

CAUTION

Use care not to scratch or damage piston rod during removal.

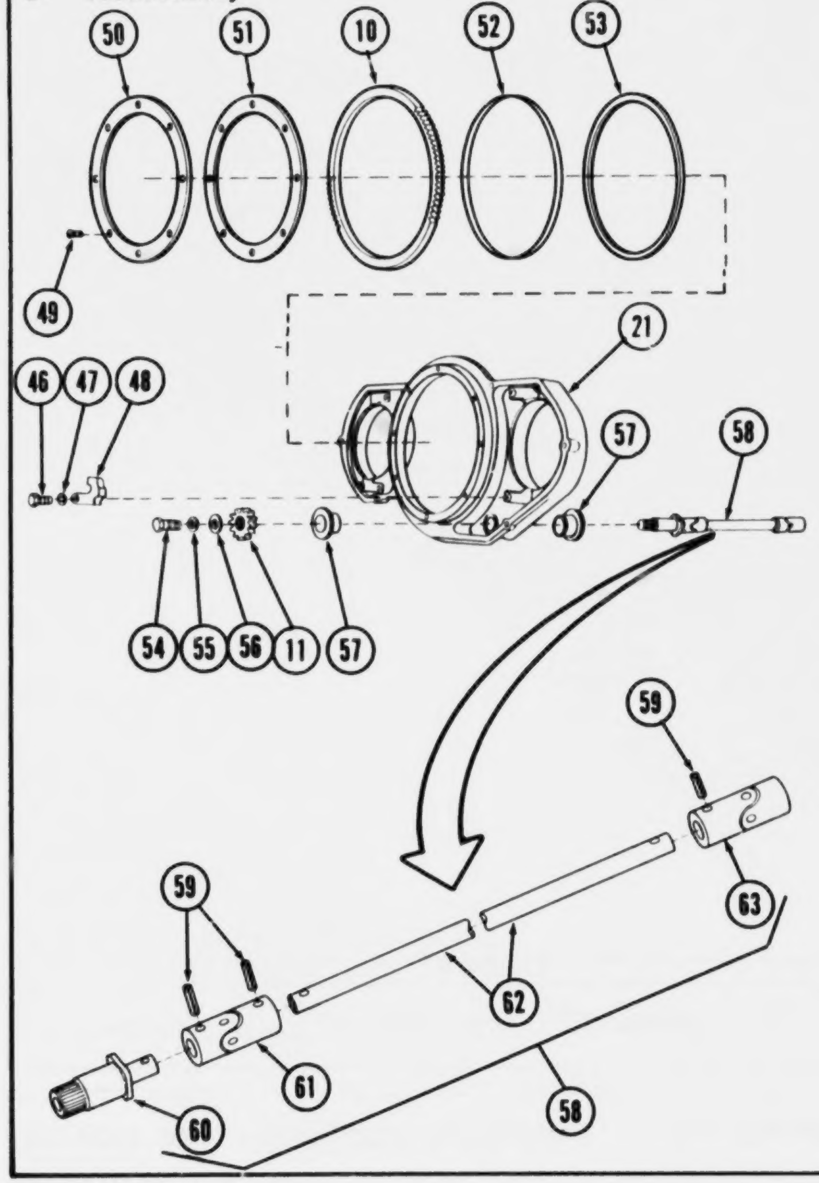




37 Remove piston assembly (36) from front of recoil cylinder (3).

38 Slide outer orifice (45) out of front of recoil cylinder (3). If outer orifice (45) is tight, a sliding hammer type puller may be used.

b. Disassembly



1 To disassemble variable recoil housing (21), remove four bolts (46), four flat washers (47) and four sector gear stops (48) from variable recoil housing (22). Discard four flat washers (47).

NOTE

Note alinement of index arrows on segment gear and spur gear before removal.

2 Remove four screws (49), retainer (50), shim (51), segment gear (10), bearing (52) and spacer (53) from variable recoil housing (21).

NOTE

Do not remove bearings from housing unless installation of new bearings is necessary.

3 Remove screw (54), lock washer (55), flat washer (56), spur gear (11), two sleeve bearings (57) and orifice control shaft assembly (58) from variable recoil housing (21). Discard lock washer (55).

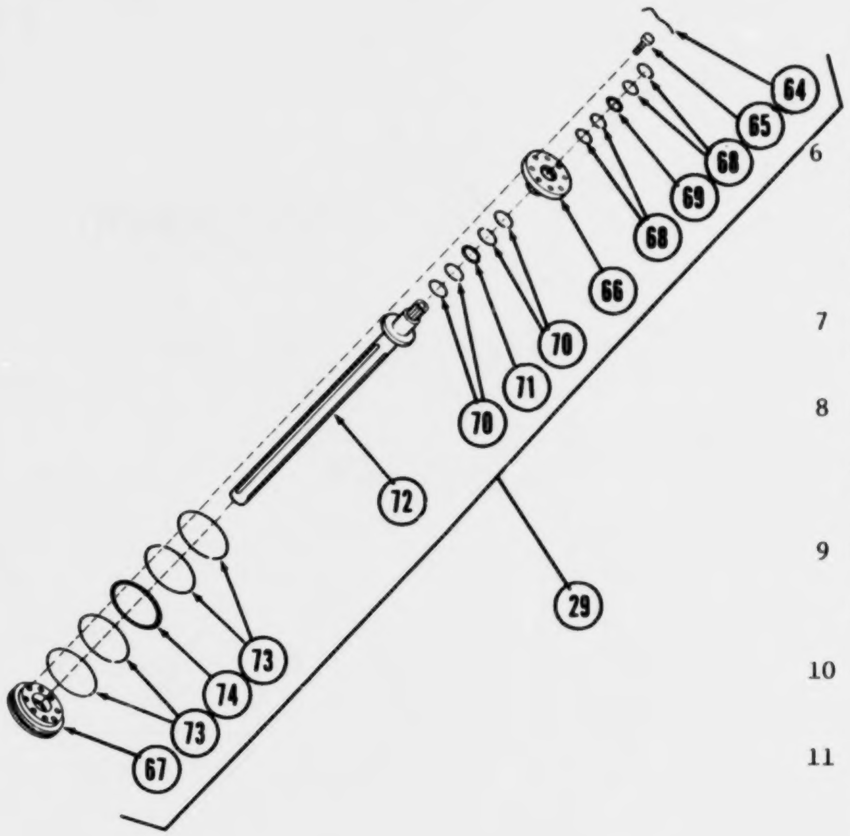
4 To disassemble orifice control shaft assembly (58), remove three spring pins (59), Discard pins (59).

5 Separate straight shaft (60), front universal joint (61), orifice control straight pin (62) and rear universal joint (63).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

b. Disassembly-Continued



NOTE

Both inner orifice and front follower groups are identical. Disassembly instructions pertain to one. Repeat instructions for remaining group.

6 To disassemble inner orifice and front follower group (29), remove lock wire (64) and eight hex head cap screws (65) from front retainer (66). Discard lock wire (64).

7 Remove front retainer (66) from front follower (67).

8 Remove four seals (68) and preformed packing (69) from inside the shaft hole of front retainer (66). Discard preformed packing (69).

9 Remove four seals (70) and preformed packing (71) from outside of front retainer (66). Discard preformed packing (71).

10 Remove front follower (67) from inner orifice rod (72).

11 Remove four seals (73) and preformed packing (74) from outside of front follower (67). Discard preformed packing (74).

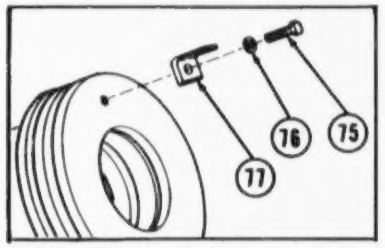
NOTE

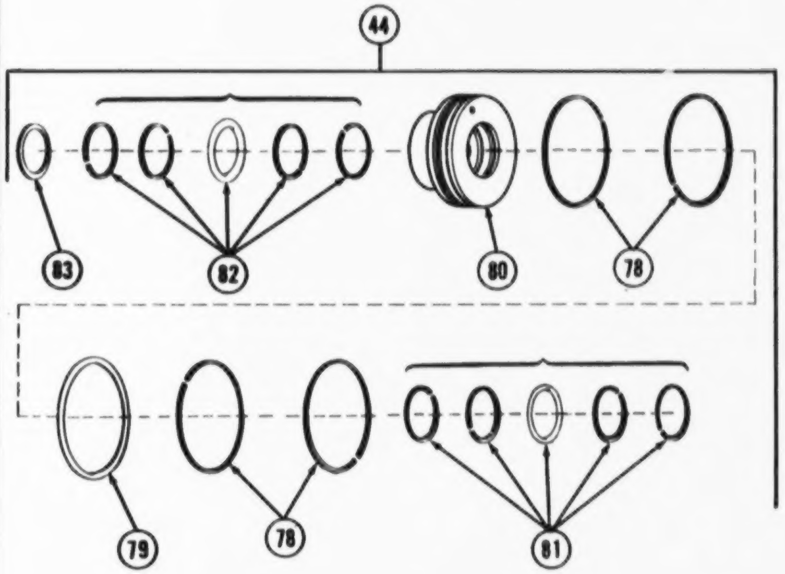
- Both piston assemblies are identical. Disassembly instructions pertain to one. Repeat instructions for remaining assembly.
- Do not disassemble piston assembly, if damaged or leaks at plug, replace piston assembly

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY – Continued

b. Disassembly-Continued





NOTE

Both rear follower groups are identical. Disassembly instructions pertain to one. Repeat instructions for remaining group.

12 To disassemble rear follower group (44), place on solid surface and remove screw (75), lock washer (76) and key (77). Discard lock washer (76).

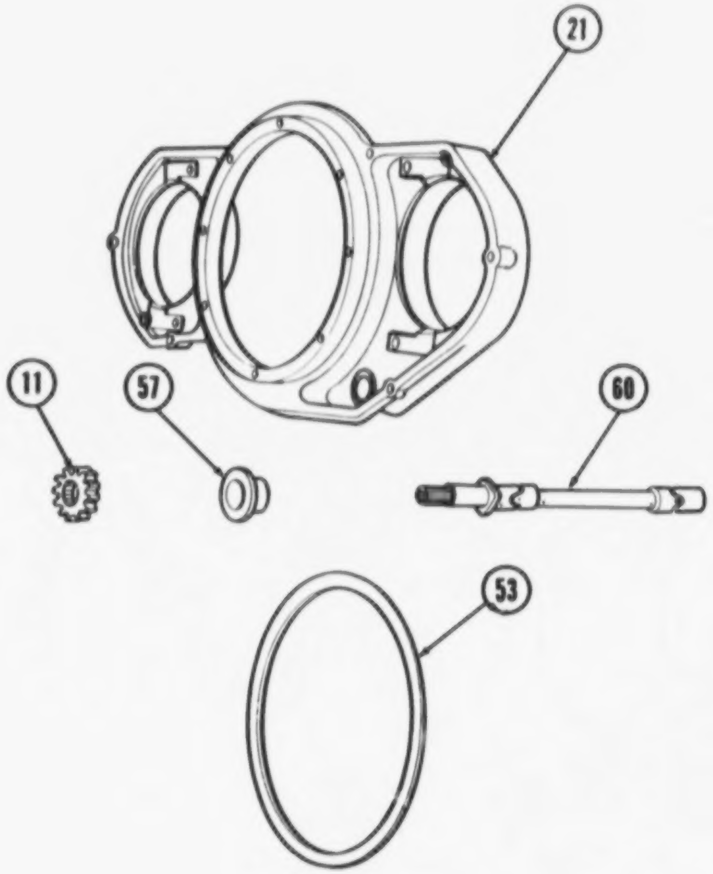
13 Remove four seals (78) and preformed packing (79) from outside of rear follower (80). Discard preformed packing (79).

14 Remove packing assembly (81) from inside front of rear follower (80). Discard packing assembly (81).

15 Remove packing assembly (82) from inside rear of rear follower (80). Discard packing assembly (82).

16 Remove felt ring (83) from rear follower (80). Discard felt ring (83).

c. Inspection and Repair



1 Inspect variable recoil housing (21). Replace if cracked or distorted. Repair or replace housing if any burrs are evident on gasket surfaces.

2 Inspect spur gear (11). Replace if cracked, broken or if splines are distorted.

3 Inspect two sleeve bearings (57). Replace if cracked, broken or distorted.

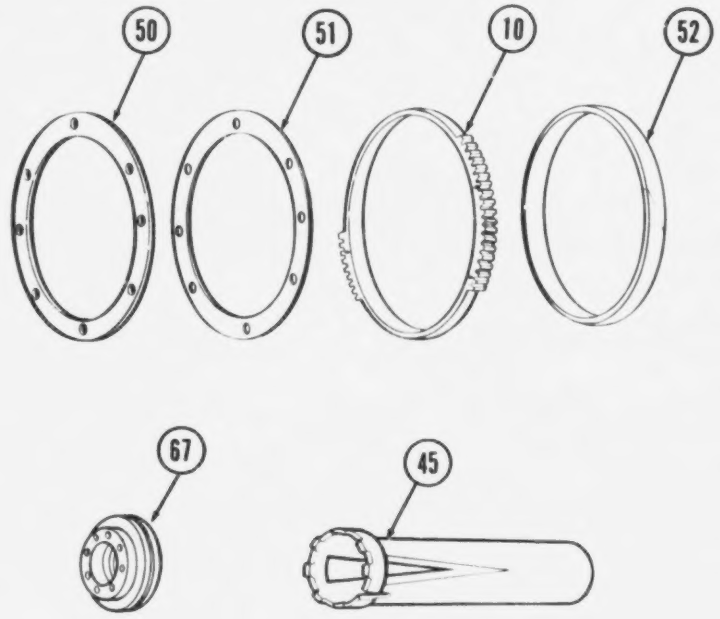
4 Inspect straight shaft (60). Replace if cracked, broken, distorted or if splines are mutilated.

5 Inspect spacer (53). Replace if cracked, broken or distorted.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

c. Inspection and Repair-Continued



6 Inspect bearing (52). Replace if cracked, broken or distorted.

7 Inspect segment gear (10). Replace if cracked, broken or distorted.

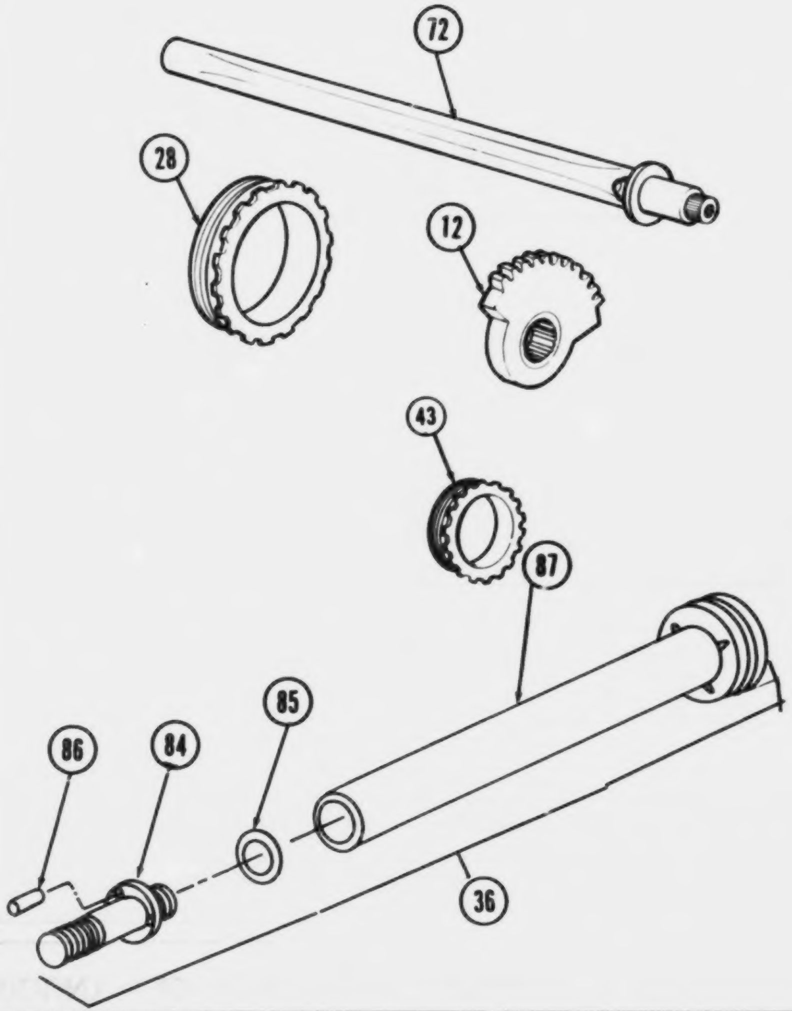
8 Measure inside diameter of segment gear (10). Replace if greater than 13.277 inches (337 mm).

9 Inspect shim (51). Replace if cracked, broken or distorted.

10 Inspect retainer (50). Replace if cracked, broken or distorted.

11 Inspect outer orifice (45). Replace if cracked, burred or distorted. Measure inside diameter. Replace if greater than 5.502 inches (140 mm).

12 Inspect front follower (67). Replace if cracked, burred or distorted.



13 Inspect inner orifice rod (72). Replace if cracked, burred or distorted. Measure outer diameter of orifice area. Replace if less than 1.992 inches (50.59 mm).

14 Inspect machine bushing (28). Replace if cracked, if spanner shoulders are rounded or if threads are mutilated.

15 Inspect two sector gears (12). Replace if gear teeth are cracked or broken or if splines are distorted.

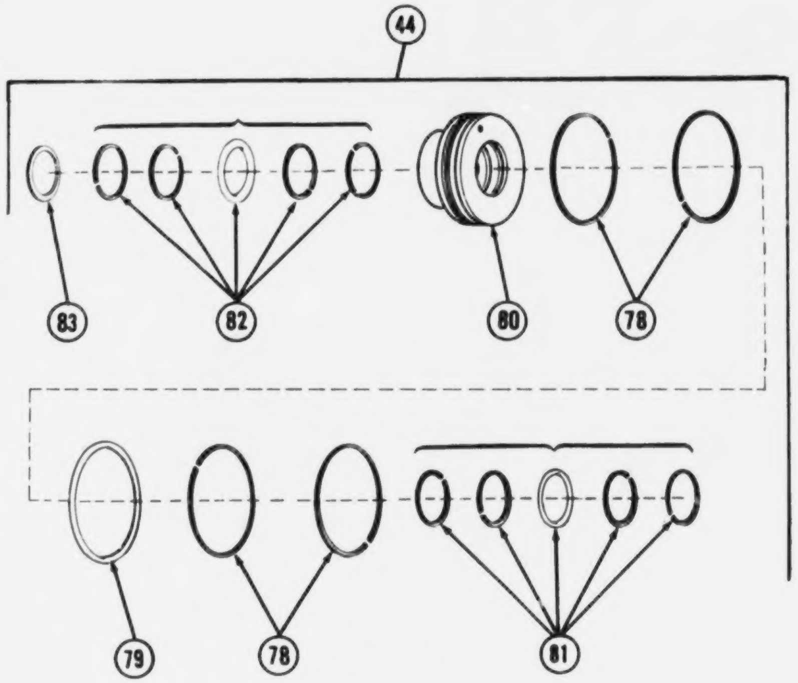
16 Inspect machine bushing (43). Replace if cracked, if spanner slot shoulders are rounded or if threads are mutilated.

17 Inspect plug (84) for mutilated threads, leakage around preformed packing (85) broken pins (86), cracked, burred or distorted piston tube (87). If any of the items are unserviceable replace piston assembly.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

d. Assembly



NOTE

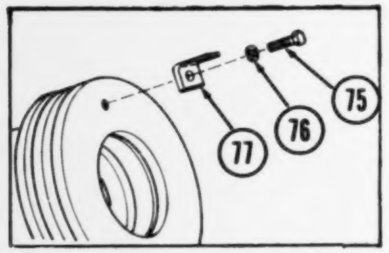
- Both rear follower groups are identical. Assembly instructions pertain to one. Repeat instructions for remaining group.
- Replacement kit P/N 5910844 will provide new felt rings, preformed packings and seals for assembly.

1 To assemble rear follower group (44), install felt ring (83) on rear follower (80).

2 Install new packing assembly (82) inside rear of rear follower (80).

3 Install new packing assembly (81) in inside front of rear follower (80).

4 Install new preformed packing (79) and four seals (78) on outside of rear follower (80).

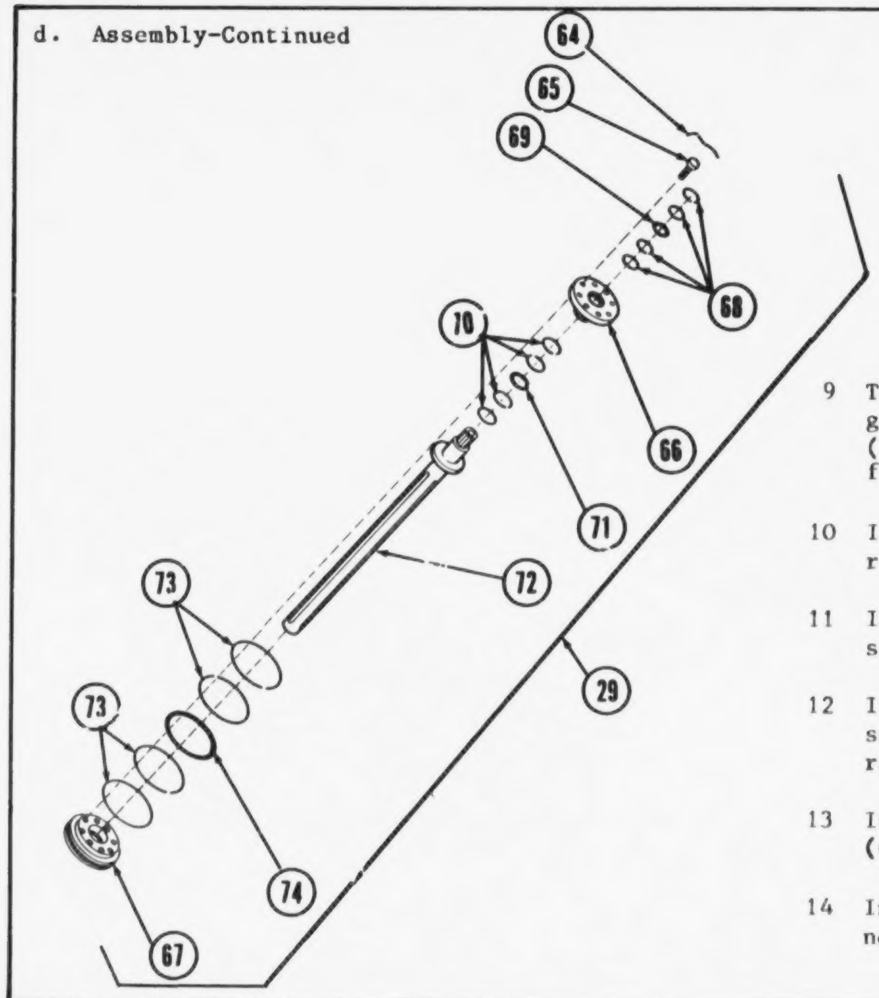


5 Install key (77), new lock washer (76) and screw (75) in rear follower group (44).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

d. Assembly-Continued



NOTE

- Both inner orifice and front follower groups are identical. Assembly instructions pertain to one. Repeat instructions for remaining group.
- When replacing seal assemblies, stagger gaps in adjacent rings 180°.

9 To assemble inner orifice and front follower group (29) install new preformed packing (74) and four seals (73) on outside of front follower (67).

10 Install front follower (67) on inner orifice rod (72).

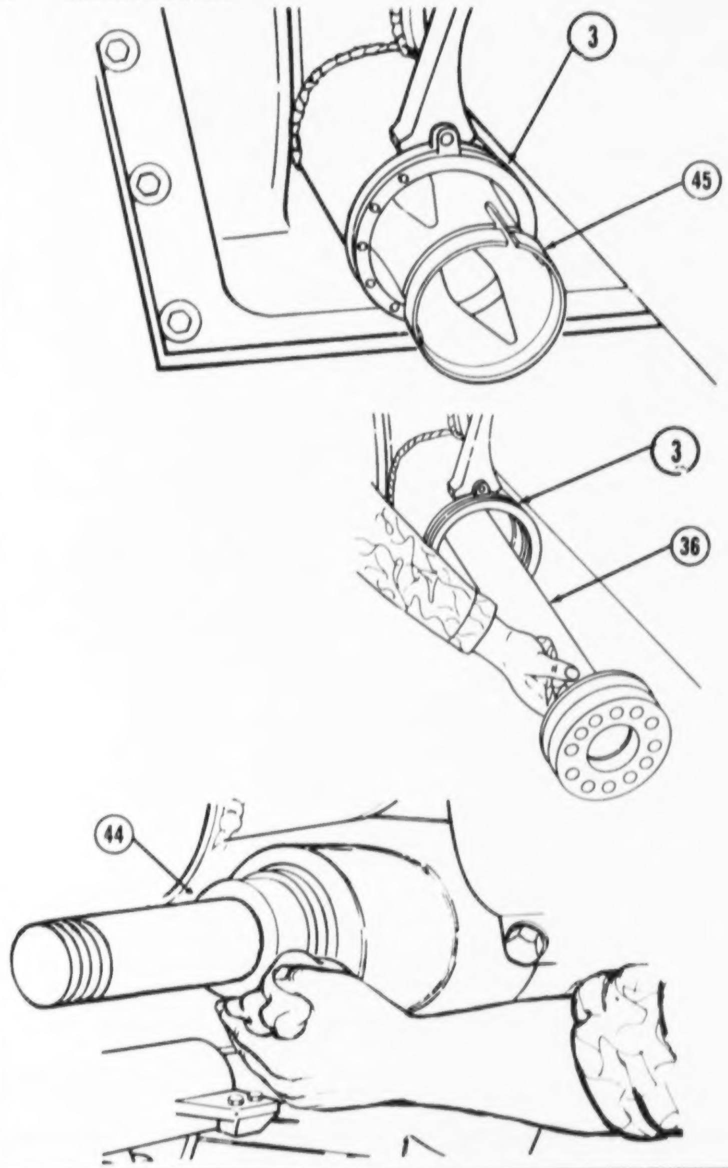
11 Install new preformed packing (71) and four seals (70) on outside of front retainer (66).

12 Install new preformed packing (69) and four seals (68) in inside shaft hole of front retainer (66).

13 Install front retainer (66) on front follower (67).

14 Install eight hex head cap screws (65) and new lock wire (64) in front retainer (69).

e. Installation



WARNING

Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.

CAUTION

Use care not to scratch or damage piston rod during installation.

1 Slide outer orifice (45) into front of recoil cylinder (3), making sure slot of outer orifice (45) is at top, lined up with oil fitting.

2 Install piston assembly (36) approximately half-way into front of recoil cylinder ( ).

NOTE

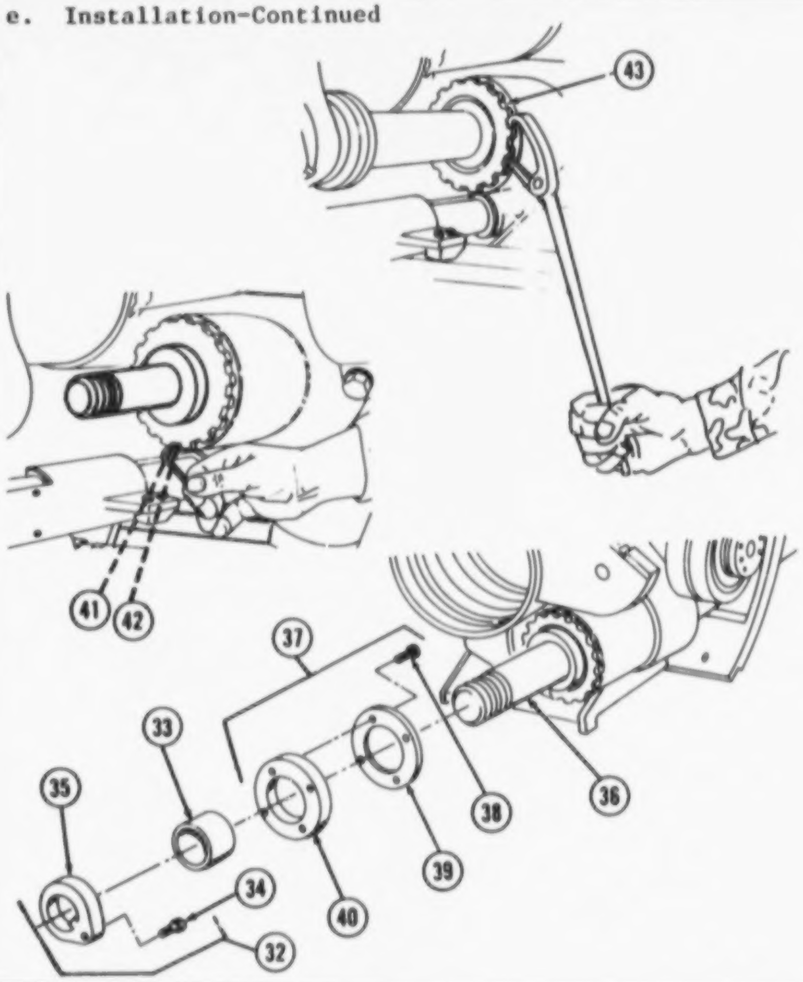
Aline key on rear follower with recesses in outer orifice.

3 Slide piston assembly further into recoil cylinder, Install rear follower group (44) at rear of recoil cylinder (3), over piston assembly rod (36).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY – Continued

e. Installation-Continued



4 Install machine bushing (43) using spanner wrench.

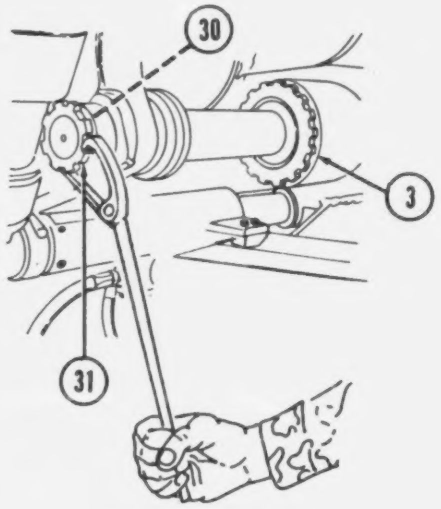
5 Install key (42) and bolt (41) using hex head wrench.

6 Install four screws (38) in thrust plate (40) and plate spacer (39).

7 Install thrust plate group (37) on rear of piston assembly (36) as piston assembly (36) is pushed into position.

8 Install pin (34) in key (35).

9 Install spacer (33) and key assembly (32) at threaded end of piston assembly (36).



10 Install key washer (30).

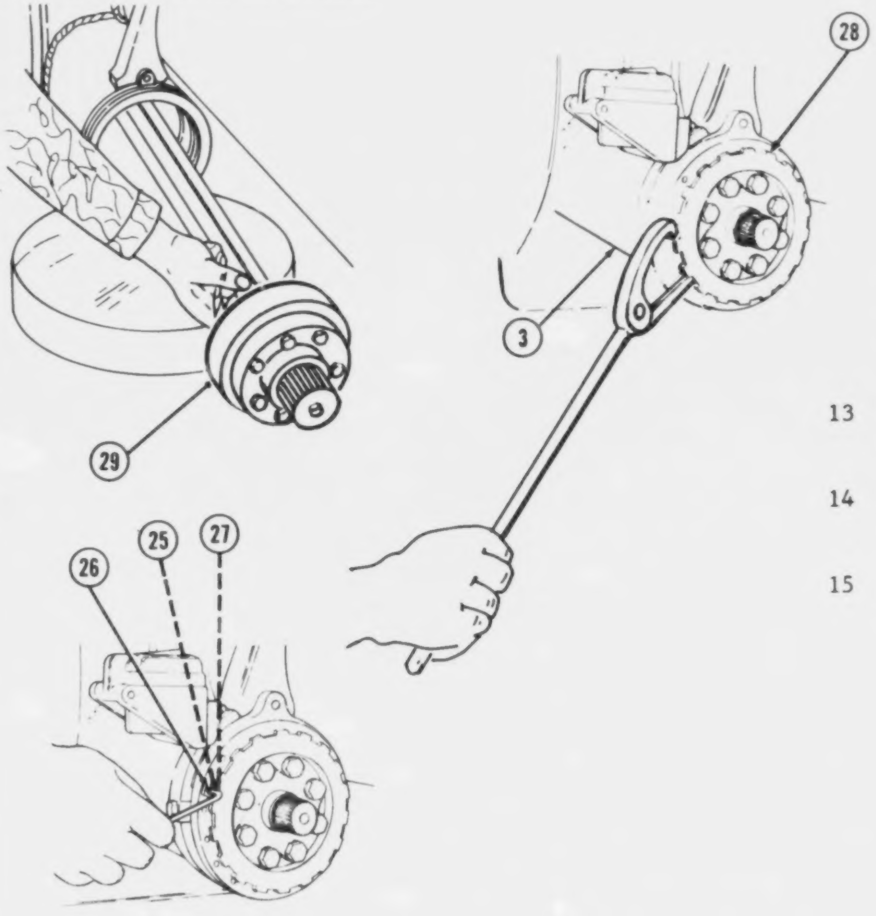
11 Install nut (31) using spanner wrench.

12 Bend tab of key washer (30) to engage it in slot of nut.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY – Continued

e. Installation-Continued



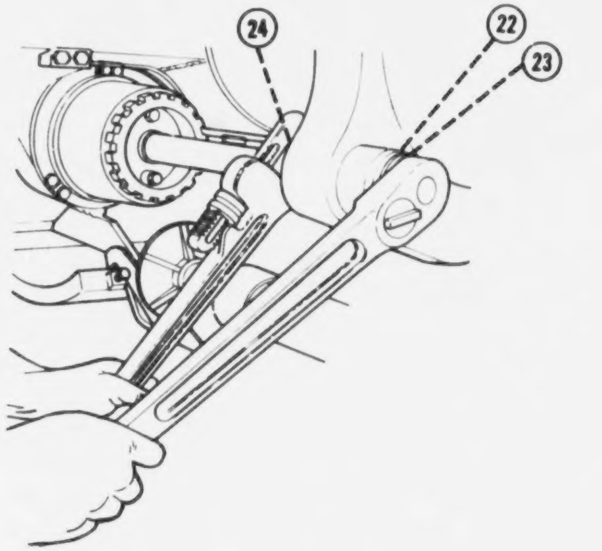
WARNING

Use gloves or rags to grip inner orifice. Edge of orifice is extremely sharp and could cause injury.

13 Install inner orifice and front follower group (29) into recoil cylinder (3).

14 Install machine bushing (28) on front of recoil cylinder (3) using spanner wrench.

15 Install key (27), bolt (26) and lock wire (25) in front of recoil cylinder (3).



16 While holding collar (24) with pipe wrench, install rear nut (23) and new cotter pin (22) on recuperator assembly.

NOTE

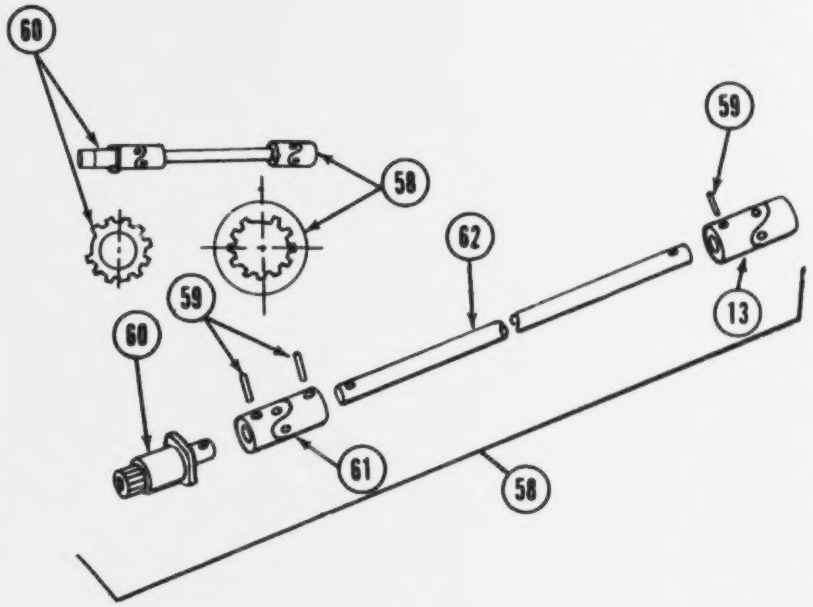
Preferred method of returning cannon to battery position is to apply nitrogen pressure to the recuperator cylinder. A wrecker boom can be used as an alternative method.

17 Pull cannon into battery position (ref. TM 9-2350-311-20-2).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

e. Installation-Continued



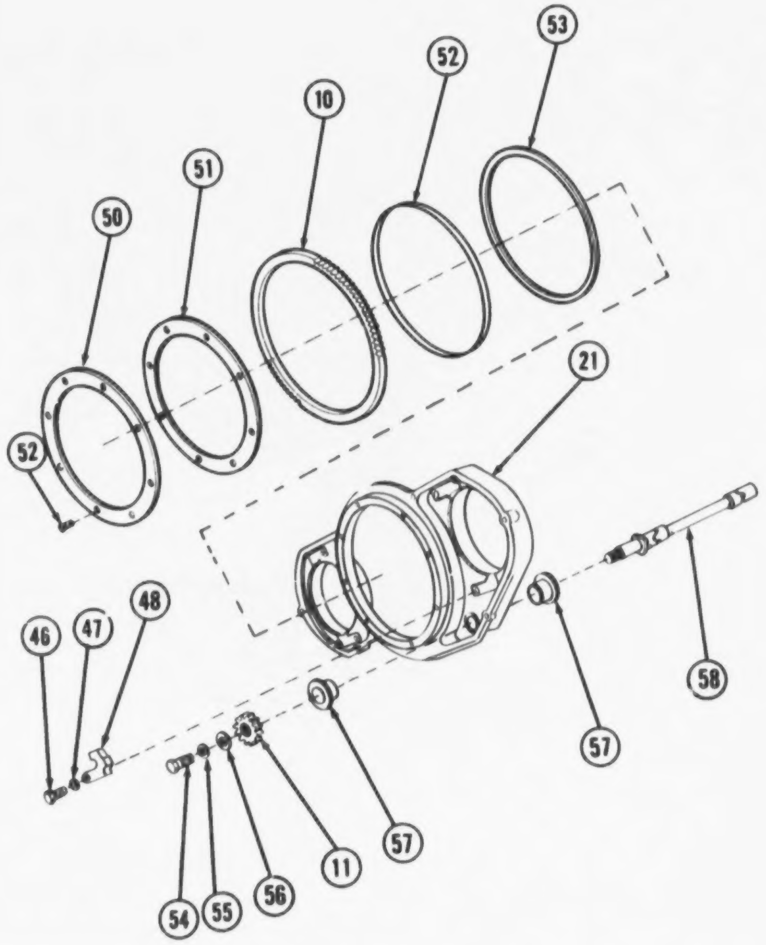
18 To assemble orifice control shaft assembly (58) connect orifice control straight pin (62) to rear universal joint (63). For new parts, drill straight pin (62) and rear universal joint (63) and install pin (59).

NOTE

Front universal joint (61) and front of straight pin (62) are not drilled for pins (59) until spur gears and sector gears are alined.

19 Install front universal joint (61) onto straight pin (62) and install straight shaft (60) into front universal joint (61).

20 Install orifice control shaft assembly onto output shaft of acturator assembly (ref. page 4-232).



NOTE

Install segment gear with alinement arrow facing to front housing assembly. Coat segment gear with GAA before installation.

21 Install spacer (53), bearing (52) and segment gear (10).

22 Install shim (51), retainer (50), four screws (49) in variable recoil housing.

23 Install sleeve bushings (57) if new parts. Ream to 1.250" ID.

24 Install four sector gear stops (48), four new flat washers (47) and four bolts (46) in variable recoil housing (22). Torque screws to 18 lb-ft (24 N.m).

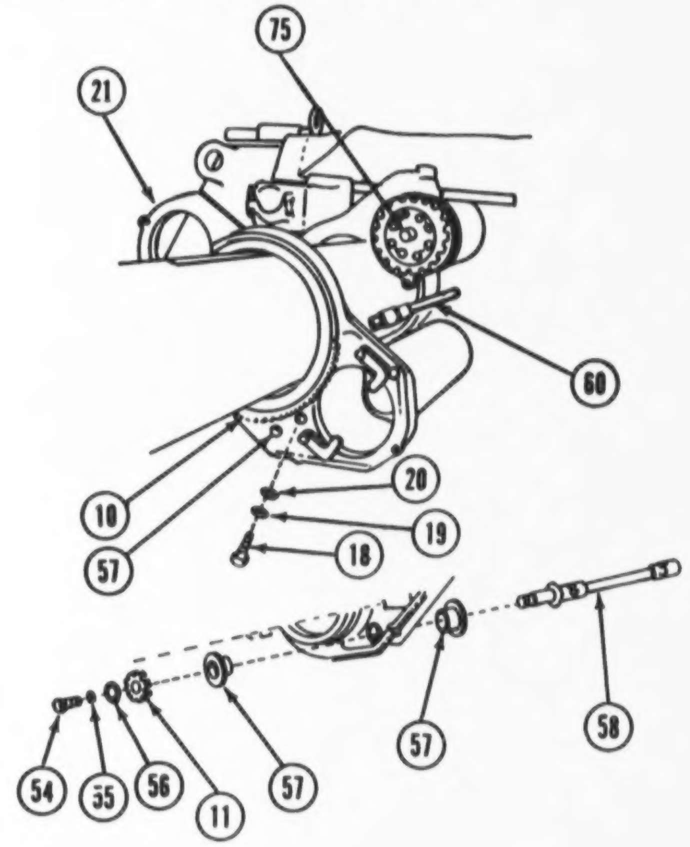
NOTE

Spur gear (11), flat washer (56), lock washer (55) and screw (54) are installed after variable recoil housing assembly are installed on mount.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY — Continued

e. Installation-Continued



25 Install variable recoil housing (21) over end of cannon tube and slide rearward along cannon tube to position at mount.

NOTE

Before assembling coat straight shaft (60), sleeve bushings (57) and spur gear (11) with GAA.

26 Slide straight shaft (60) of orifice control shaft assembly (58) through sleeve bushings and position variable recoil housing assembly (21) on mount.

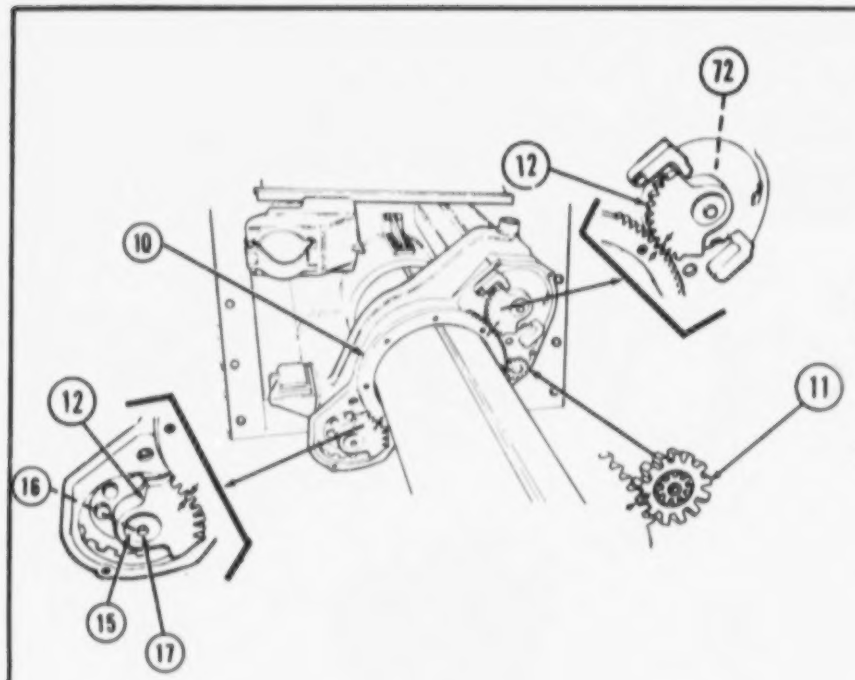
27 Install four flat washers (20), four new lock washers (19) and four screws (18) on variable recoil housing (21).

28 Aline spur gear (11) with splines on straight shaft (60) and segment gear (10) arrow and install spur gear (11).

29 Install flat washer (56), lock washer (55) and screw (54).

NOTE

Do not torque screw (54) at this time.



NOTE

Coat sector gears (12) and head of screws on front follower with GAA (Item 9, App. C) before installing sector gears (12).

30 Aline sector gears (12) with splines on inner orifice shaft (72) and arrow or segment gear (10) install sector gears (12).

31 Install flat washer (17), new lock washers (16) and screw (15), on each inner orifice shaft (72).

NOTE

Check alinement of inner orifice shaft, sector gears, segment gear, spur gear and position of actuator output shaft.

With everything in proper alinement (for long recoil length) drill holes for pins (59) on front universal joint (61) of orifice control shaft assembly, (58)

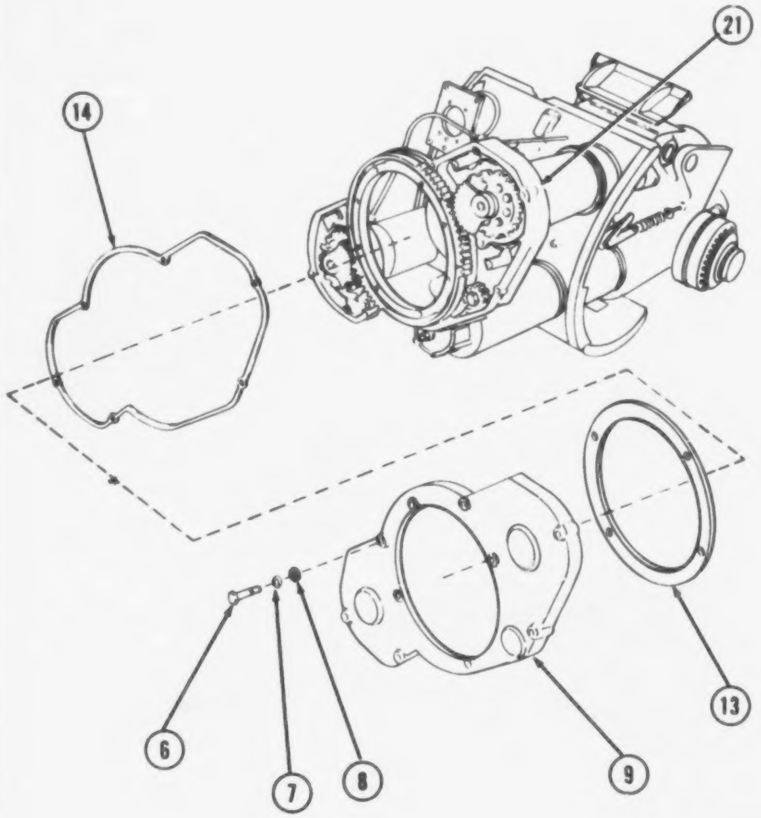
32 Install pins (59) in front universal joint (61).

33 Torque screw (54) to 35 LB-FT (47NCM).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-15. VARIABLE RECOIL ASSEMBLY – Continued

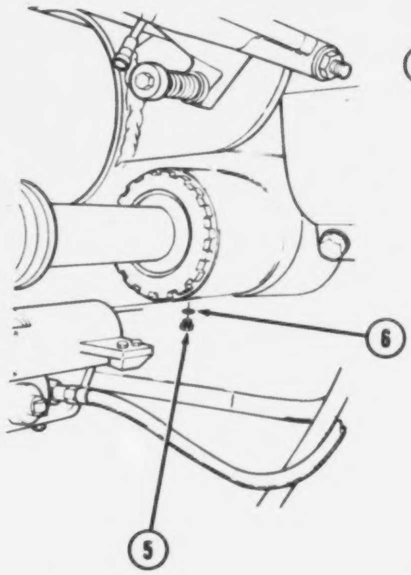
e. Installation-Continued

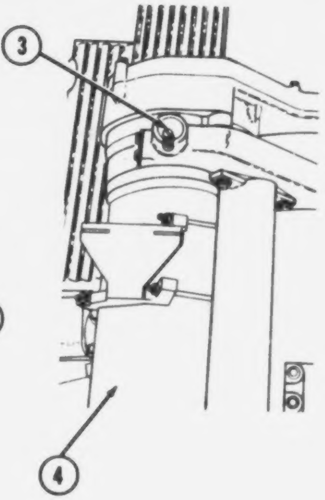


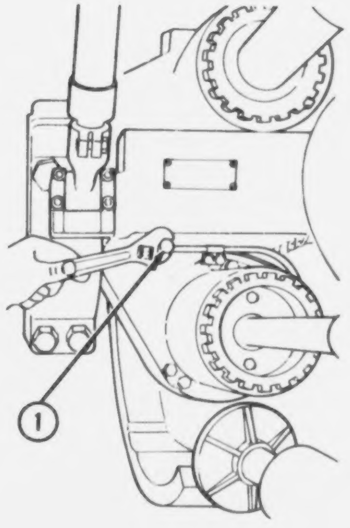
34 Install gaskets (13 and 14) and variable recoil housing cover (9) over end of cannon tube and slide rearward along cannon tube to position at variable recoil housing (21).

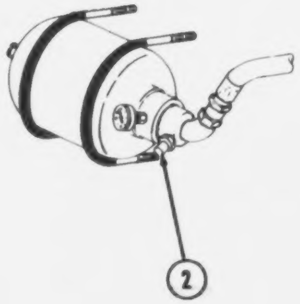
35 Install six flat washers (8), six new lock washers (7) and six bolts (6) in variable recoil housing cover (9).

36 Install dust cover (ref. page 4-93).









37 Install two new preformed packings (5) and recoil cylinder drain plugs (4) at rear of each recoil cylinder (3).

38 Recharge recuperator with dry nitrogen (ref. page 4-168).

39 Close bleeder "T" (2) at front of left recoil cylinder (3).

40 Close accumulator replenisher right manifold bleeder plug (1).

41 Recharge replenisher hydraulic system with hydraulic fluid (Item 11, App.C) (ref. TM 9-2350-311-20).

42 Install valve cap on accumulator replenisher assembly oil filling valve.

43 Check variable recoil for hydraulic leaks.

44 Install evacuator (ref. page 4-78).

45 Install muzzle brake (ref. page 4-75).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-16. BUFFER ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection
d. Assembly e. Installation

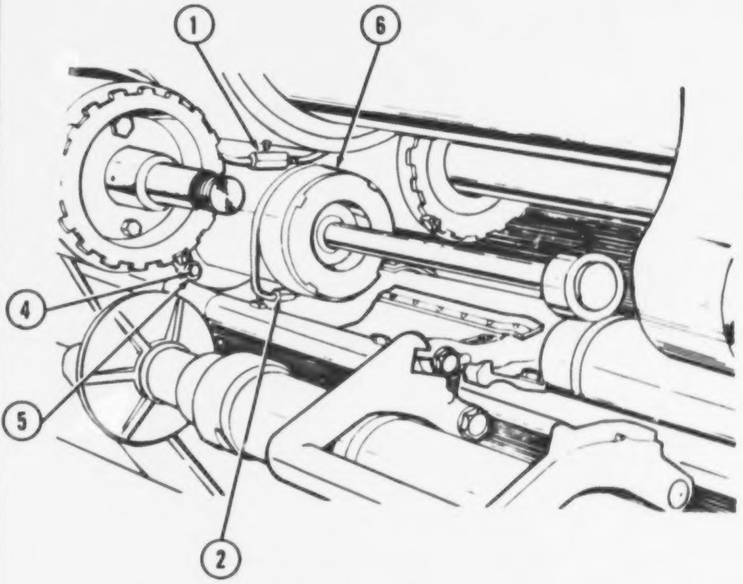
INITIAL SET-UP

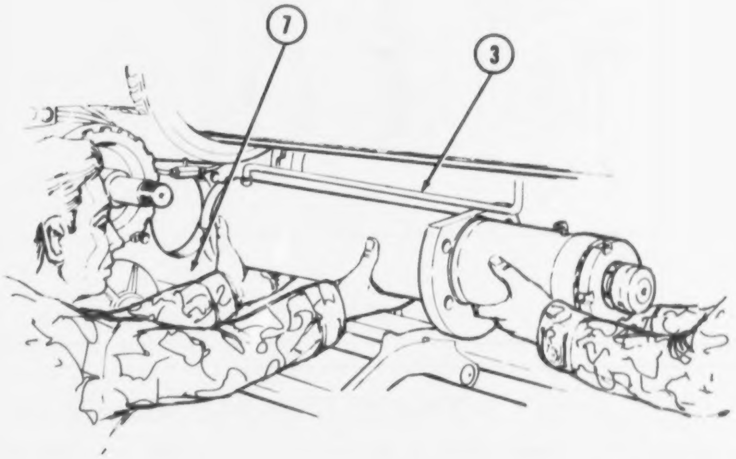
Materials/Parts	Test Equipment	Personnel Required
Seal replacement kit P/N 5910848	Calipers Micrometers, inside and outside	2

a. Removal

WARNING

- When working with cannon pushed out of battery, block breech with breech stand or chain cannon tube to hull to prevent accidental elevation of tube and injury to personnel.





NOTE

Buffer assembly can be removed and installed with mount and cannon installed in vehicle.

1 Drain replenisher hydraulic system (ref. page 4-181).

2 Remove recuperator rod nut (ref. page 4-147).

3 Push cannon out of battery 30 inches (762 mm) refer to TM 9-2350-311-20-2).

NOTE

When bottom hydraulic line is disconnected, remaining oil in recoil system will drain.

4 Disconnect three rear hydraulic lines from buffer assembly (6) at top nut (1) and bottom nut (2) on buffer assembly (6). Disconnect front line elbow (3) (not shown).

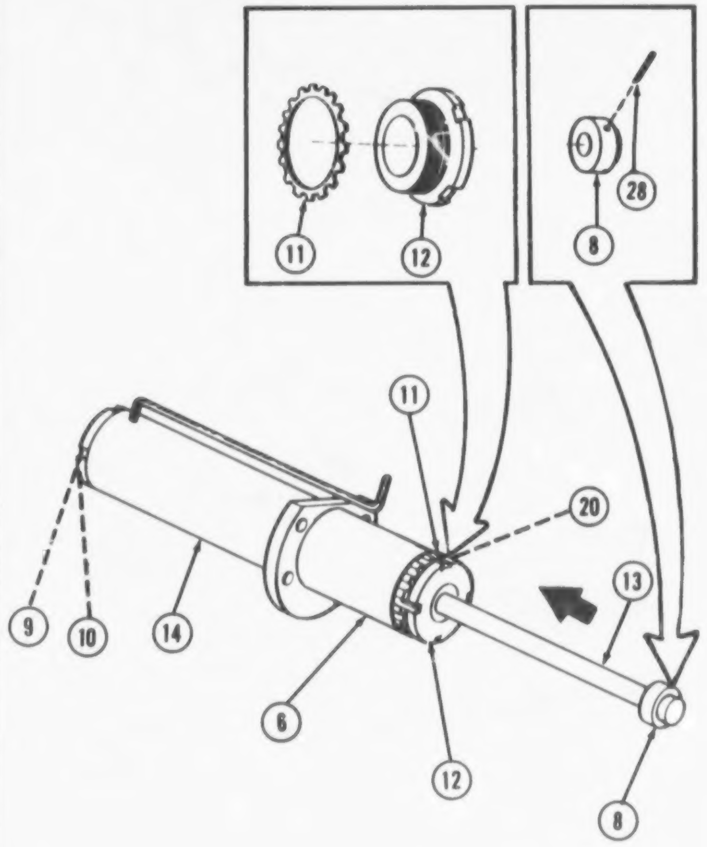
5 **Remove four screws (4) and four washers (5) from buffer assembly (6) flange.**

6 **Withdraw buffer assembly (6) from cradle assembly (7).**

MOUNT AND HOWITZER ASSEMBLY — Continued

4-16. BUFFER ASSEMBLY — Continued

b. Disassembly



1 Place buffer assembly (6) in vise and secure.

2 Push in bumper (8) against spring (20) to gain access to nut (9).

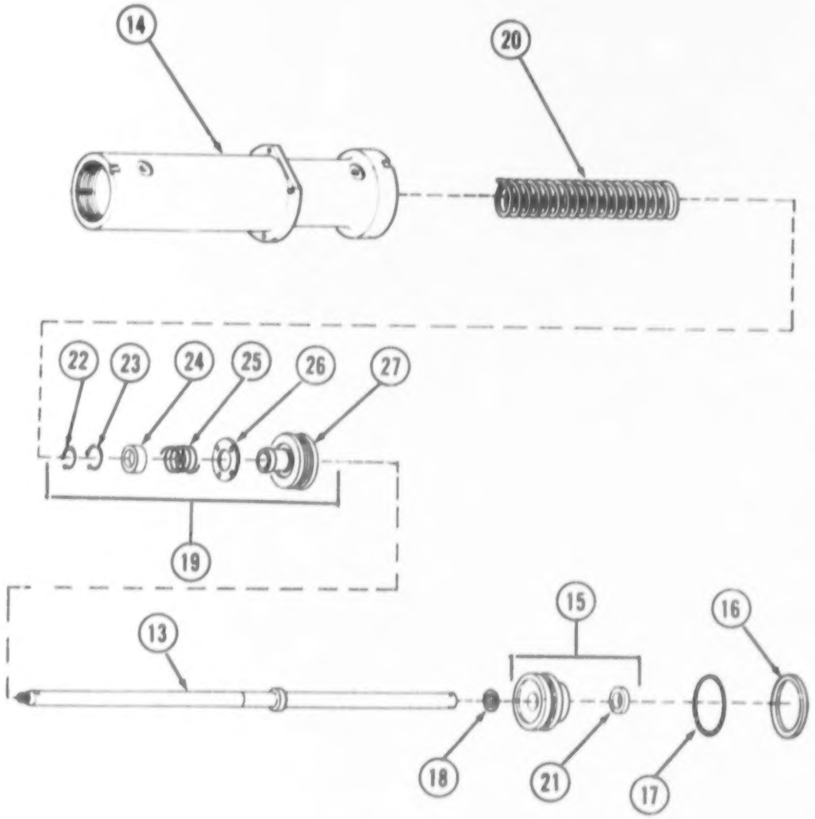
WARNING

Spring is under compression. Use care in disassembly to avoid possible injury to personnel.

3 Drive out spring pin (10) and remove nut (9). Allow bumper (8) and piston rod (13) to extend fully out of cylinder (14). Discard spring pin (10).

4 Disengage key washer (11) locking teeth from machine bushing (12) at bumper (8) end.

5 Restrain bumper (8) against further extension. Have an assistant unscrew machine bushing (12). Allow bumper (8) and piston rod (13) to extend slowly.



6 Withdraw bumper (8) and piston rod (13) from cylinder (14) along with bushing assembly (15), retainer (16), preformed packing (17), seal (18), piston group (19) and spring (20).

7 Remove bumper (8) by driving out spring pin (28). Discard spring pin (28).

8 Remove machine bushing (12), key washer (11), bushing assembly (15), retainer (16), preformed packing (17), seal (18) and seal (21) from bushing assembly (15). Discard retainer (16), performed packing (17) and seals (18 and 21).

WARNING

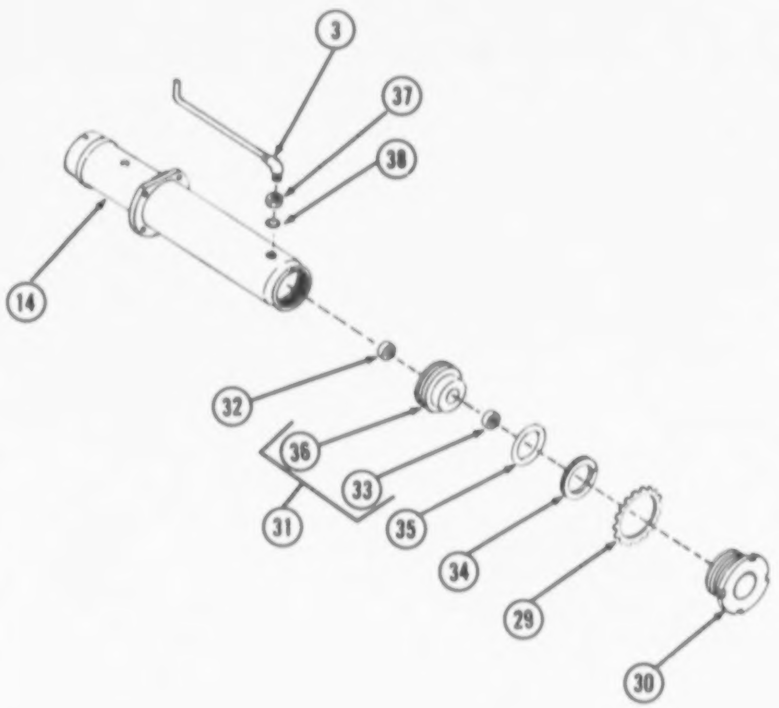
Spring is under compression. Use care in disassembly to avoid possible injury to personnel.

9 Disassemble piston group (19) by removing retaining rings (22) and (23). Separate guide (24), spring (25), valve (26) and piston (27).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-16. BUFFER ASSEMBLY — Continued

b. Disassembly-Continued



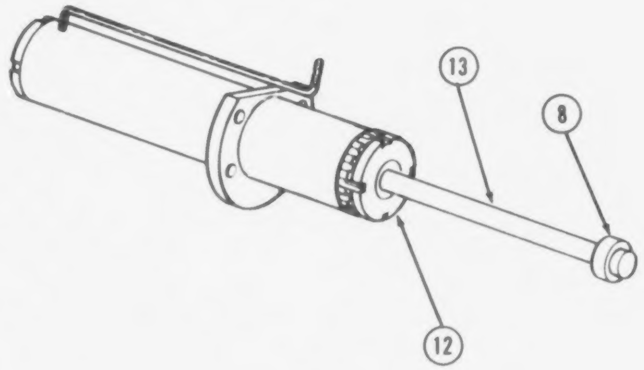
10 Disengage key washer (29) locking teeth from machine bushing (30) at stop end.

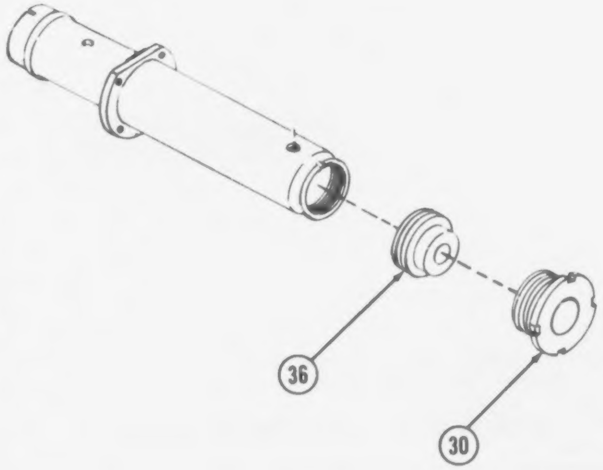
11 Unscrew machine bushing (30) and remove with key washer (29). Discard key washer (29).

12 Withdraw bushing assembly (31) along with seals (32 and 33), retainer (34) and preformed packing (35). Discard seals (32 and 33), retainer (34) and preformed packing (35).

13 Remove front line elbow (3), nut (37) and preformed packing (38) from front of cylinder (14). Discard preformed packing (38).

c. Inspection





1 Inspect bumper (8). Replace as an assembly if there are burrs, cracks, sharp edges or other damage.

2 Inspect bushings (12,30 and 36) for burrs or sharp edges. Replace if needed.

3 Measure inside diameter of bushings (30 and 36). Replace if inside diameter is greater than 1.000 inches (25.4 mm).

4 Inspect piston rod (13) for damage or wear. Replace if scored, scratched or excessively worn. Replace if threads are burred or nicked. Remove any paint on rod.

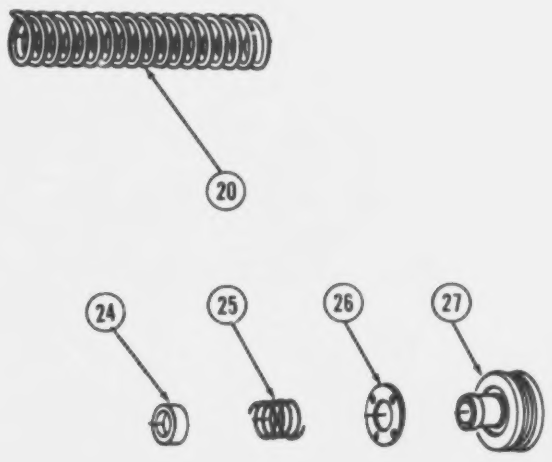
5 Inspect cylinder (14) for damage. Replace if exterior is cracked, dented or deformed. Replace if interior is scratched, galled or excessively worn.

6 Measure inside diameter of cylinder (14) in two places. At 20 inches (508 mm) for stop end, replace if greater than 3.51 inches (89.15 mm). At 8.5 inches (215.9 mm) from stop end, replace if greater than 3.5 inches (89 mm).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-16. BUFFER ASSEMBLY — Continued

c. Inspection-Continued



7 Inspect piston (27) for damage. Replace if nicked, scratched or burred.

8 Measure outside diameter of piston (27). Replace if less than 3.487 inches (88.56 mm).

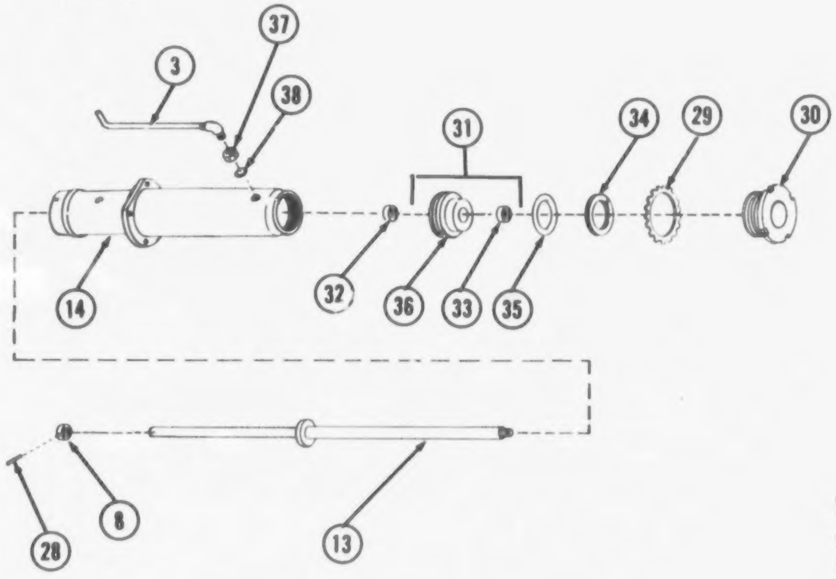
9 Inspect valve (26) for burrs or sharp edges. Replace as required.

10 Measure valve (26) thickness. Replace if less than 0.12 inches (3 mm).

11 Inspect guide (24) for burrs or sharp edges. Replace as required.

12 Inspect two springs (25) and (20). Replace if cracked or distorted.

d. Assembly



NOTE

Use new seals, preformed packings and retainers on assembly, using seal replacement kit P/N 5910848.

1 Install new preformed packing (38), nut (37) and front line elbow (3) at front of cylinder (14).

2 Install two new seals (32 and 33) onto bushing (36).

3 Install new preformed packing (35), new retainer (34) on bushing assembly (31) and insert bushing assembly (31) into cylinder (14).

4 Install machine bushing (30) with new key washer (29).

5 Engage key washer (29) locking teeth to machine bushing (30) at stop end.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-16. BUFFER ASSEMBLY — Continued

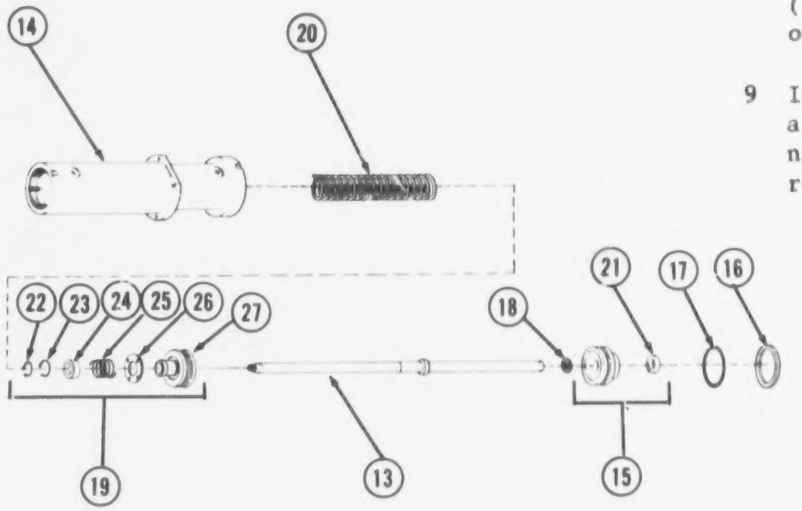
d. Assembly-Continued

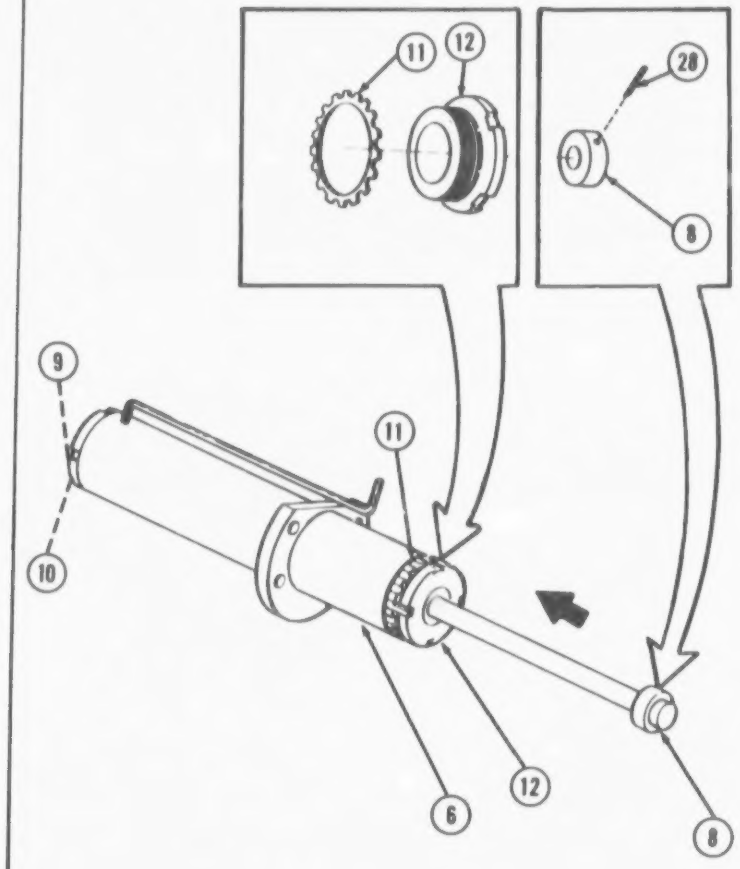
6 Assemble piston (27), valve (26), spring (25) and guide (24). Carefully compress spring (25). Install retaining rings (22 and 23).

7 Install two new seals (18 and 21), new preformed packing (17) and new retainer (16) onto bushing assembly (15).

8 Install machine bushing (12), key washer (11), bumper (8) and spring pin (28) on end of piston rod (13).

9 Install piston rod (13) into cylinder (14) along with spring (20), piston group (19), new seal (18), new preformed packing (17), retainer (16) and bushing assembly (15).





WARNING

Insure spring is tightly compressed. Use care in assembly to prevent accidental release of spring, resulting in possible injury to personnel.

10 Push bumper (8) until piston rod (13) is in a position that allows assistant to install key washer (11) and machine bushing (12). Allow bumper (8) to extend slowly.

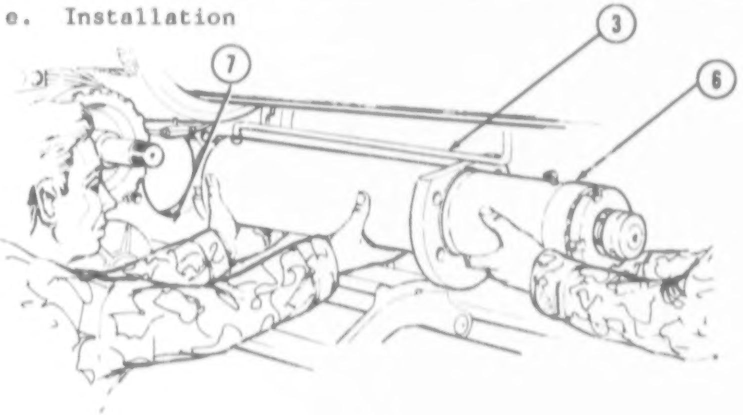
11 Engage key washer (11) locking teeth to machine bushing (12) at bumper (8) end.

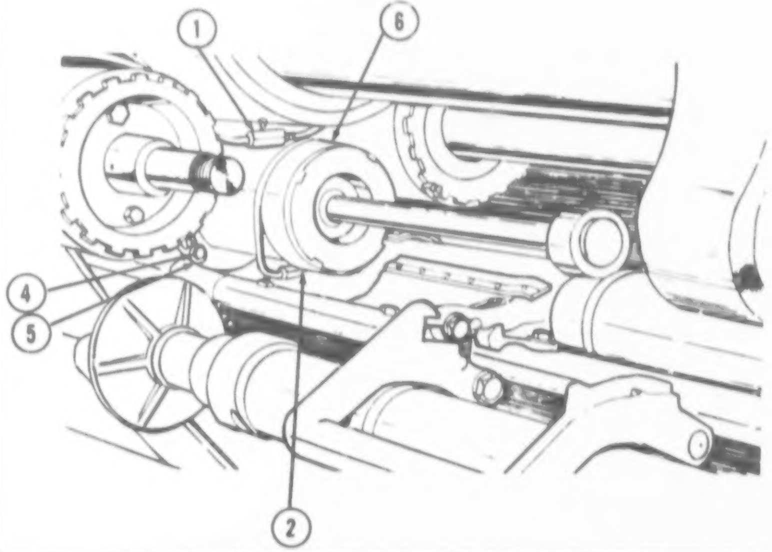
12 While one person compresses bumper (8) and holds it in position, assistant installs nut (9) and new spring pin (10).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-16. BUFFER ASSEMBLY — Continued

e. Installation





1 Insert buffer assembly (6) into cradle assembly (7).

2 Install four washers (5) and four screws (4) into buffer assembly (6) flange. Torque screws to 38 lb-ft (51 N·m).

3 Connect front line elbow (3) and three rear hydraulic lines to buffer at bottom nut (2) and top nut (1) on buffer assembly.

4 Return cannon into battery position ref. TM 9-2350-311-20-2.

5 Replace recuperator rod nut and new cotter pin.

6 Fill replenisher hydraulic system (ref. page 4-234 and TM 9-2350-311-20-2).

7 Check buffer assembly and hydraulic line for leaks.

4-17. ACTUATOR AND FOLLOWER ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts	Test Equipment
Lock washers	Calipers
Lock wire	Inside and outside micrometers
Shims	
Spring pins	

a. Removal

NOTE

Actuator and follower procedures can be performed while mount and cannon are installed in vehicle.

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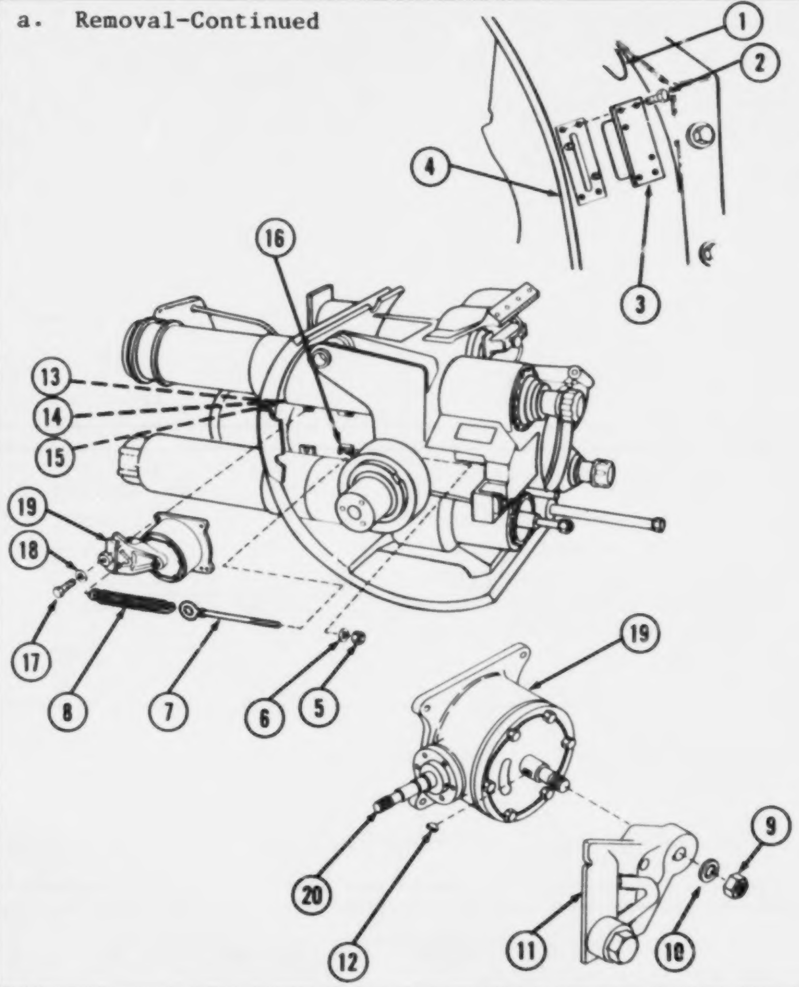
MOUNT AND HOWITZER ASSEMBLY— Continued

4-17. ACTUATOR AND FOLLOWER ASSEMBLY – Continued

a. Removal-Continued



1 Before removing follower (3), remove weather cover (ref. page 8-2) and upper rotor (ref. page 4-6).

2 For removal of follower (3), remove lock wire (1), four screws (2) and follower (3) from upper left front of trunnion bracket assembly (4). Discard lock wire (1).

3 For removal of actuator (19), remove nut (5), flat washer (6), eyebolt (7) and spring (8).

4 Remove nut (9), lock washer (10), cam lever assembly (11) and woodruff key (12). Discard lock washer (10).

5 Elevate cannon, remove upper front screw (14) and lock washer (15). Discard lock washer (15).

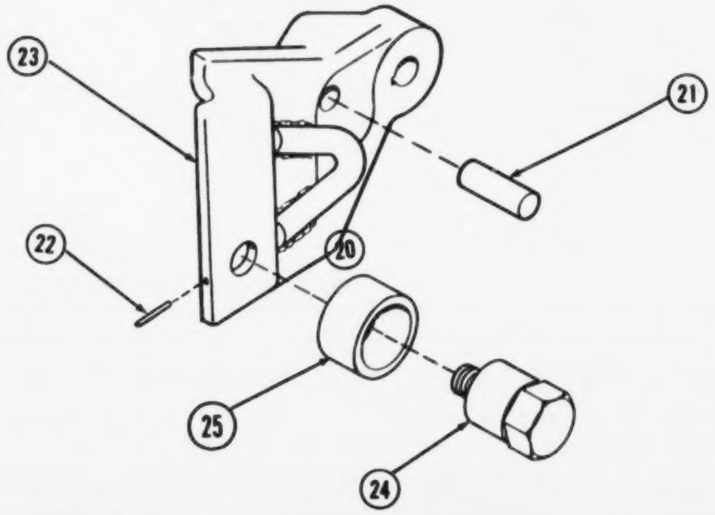
6 Depress cannon and remove three screws (17) and three lock washers (18). Discard three lock washers (18).

7 Using prybar, pry actuator from mount. Dowel pins (13) and (16) may come off with actuator or stay in mount.

8 Move actuator (19) to the rear to disengage bevel gear shaft (20) from universal joint. Remove actuator (19).

9 If, dowel pins (13 and 16) were removed with actuator, remove pins from actuator, if not remove from mount.

b. Disassembly



NOTE

- **Remove limiting pin from cam lever only if inspection indicates replacement is necessary.**
- **Disassemble cam lever assembly only if required.**

1 Remove limiting pin (21), if necessary.

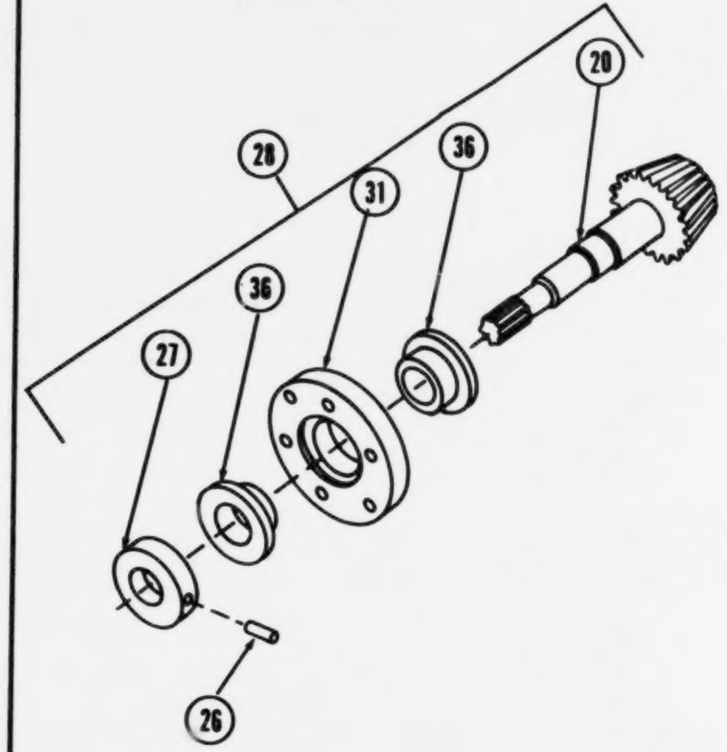
2 Remove spring pin (22) from cam lever (23).

3 Remove shoulder bolt (24) and bearing (25).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-17. ACTUATOR AND FOLLOWER ASSEMBLY – Continued

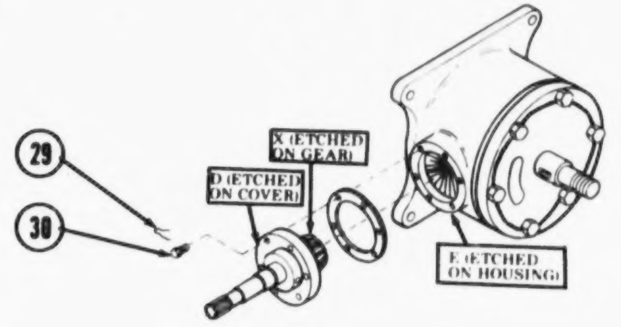
b. Disassembly-Continued



4 Remove spring pin (26) and spacer (27) from bevel gear shaft assembly (28).

5 Remove lock wire (29) and six screws (30) from cover (31). Discard lock wire (29).

6 Withdraw bevel gear shaft (20) from actuator (19).


29
30
X (ETCHED ON GEAR)
D (ETCHED ON COVER)
E (ETCHED ON HOUSING)

NOTE

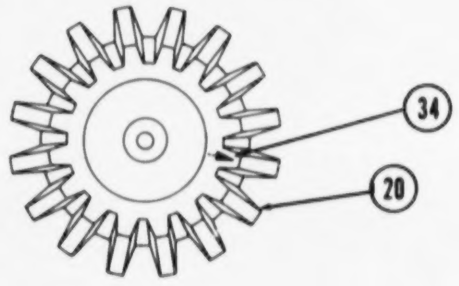
Remove sleeve bearings only if inspection indicates replacement is necessary.

7 Remove two sleeve bearings (36), if necessary.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-17. ACTUATOR AND FOLLOWER ASSEMBLY — Continued

b. Disassembly-Continued

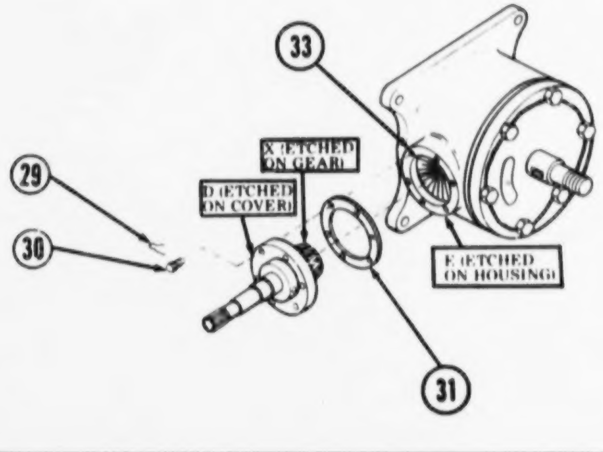


Note matching arrows (34) on bevel gear shaft (20) and sector gear (33).

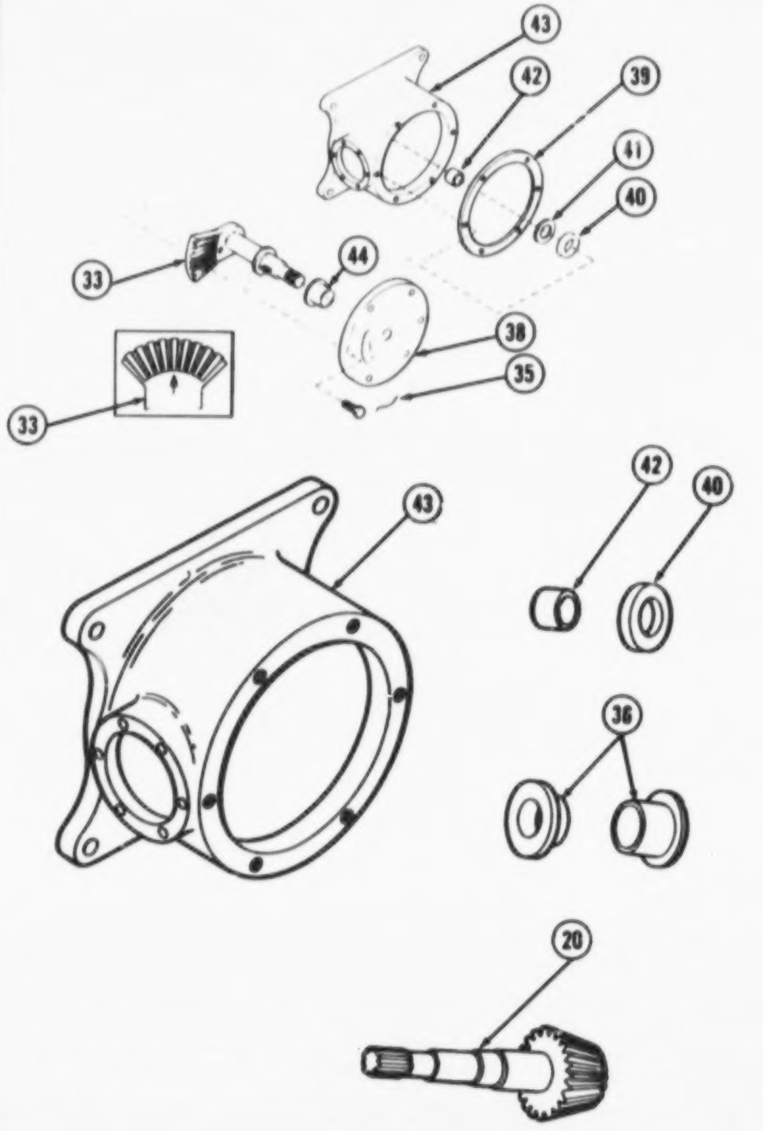
8 Remove shim(s) (32), if any. Measure thickness. Note dimension D etched on cover (31), dimension X etched on sector gear (33) and dimension E etched on actuator housing (43).

9 Remove lock wire (35) and six screws (37). Discard lock wire (35).

10 Withdraw cover (38), cover shim (39), sector gear shaft sleeve bearing (44), thrust bearing (40), thrust bearing shim (41) and sleeve bearing (42) from actuator housing (43).


33
X (ETCHED ON GEAR)
D (ETCHED ON COVER)
29
30
E (ETCHED ON HOUSING)
31

c. Inspection and Repair



1 Measure inside diameter of two sleeve bearings (36). Replace if inside diameter is greater than 1.0005 inches (25.41 mm) (installed in pairs and reamed).

2 Inspect bevel gear shaft (20). Replace if cracked or distorted. Measure outside diameter of bearing journal. Replace if outside diameter is less than 0.9995 inch (25.38 mm).

3 Inspect actuator housing (43). Replace if cracked or distorted.

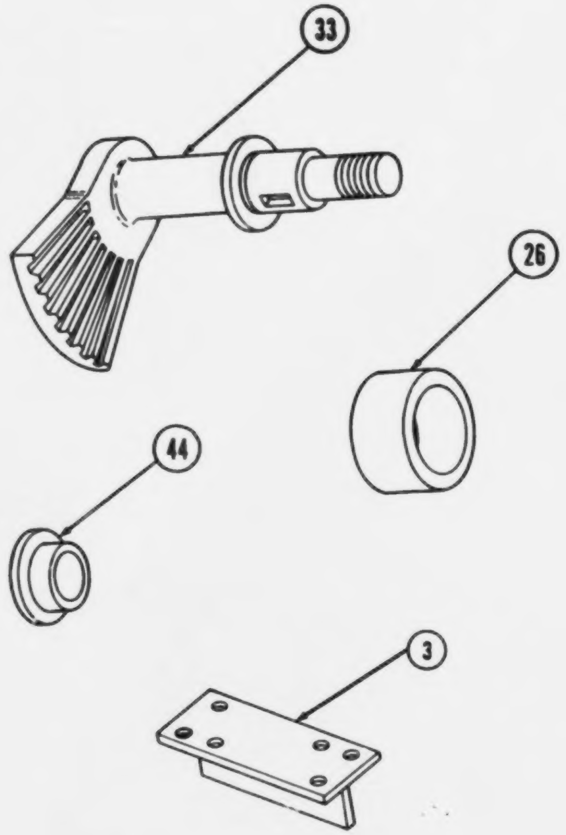
4 Measure inside diameter of sleeve bearing (42). Replace if inside diameter is greater than 1.0010 inches (25.42 mm) (installed and reamed).

5 Measure thickness of thrust bearing (40). Replace if thinner than 0.12 inch (3 mm).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-17. ACTUATOR AND FOLLOWER ASSEMBLY — Continued

c. Inspection and Repair-Continued



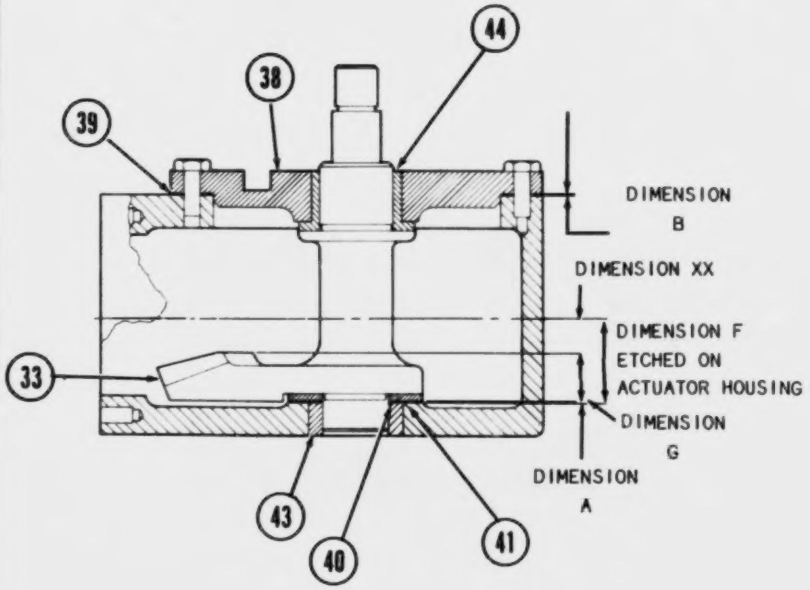
6 Inspect sector gear shaft (33). Replace if cracked or distorted. Measure outside diameter of bearing journals. Replace if outside diameter is less than 0.998 inches (25.34 mm). Measure housing end and cover end. Replace if outside diameter is less than 1.123 inches (28.52 mm).

7 Measure inside diameter of sleeve bearing (44). Replace if inside diameter is greater than 1.126 inches (28.60 mm).

8 For proper cleaning, inspection and lubrication procedures for bearing (26), refer to TM 9-214.

9 Inspect follower (3). Replace if cracked or distorted.

d. Assembly


44
38
39
DIMENSION B
DIMENSION XX
DIMENSION F ETCHED ON ACTUATOR HOUSING
33
DIMENSION G
DIMENSION A
43
40
41

1 To assemble actuator, determine dimension B of vocer shim (39). Assemble thrust bearing shims (41) (ref. page 4-227), thrust bearing (40), sector gear shaft (33), sleeve bearing (44) and cover (38) (ref. page 4-227) in actuator housing (43).

NOTE

Make sure all components are seated firmly against each other.

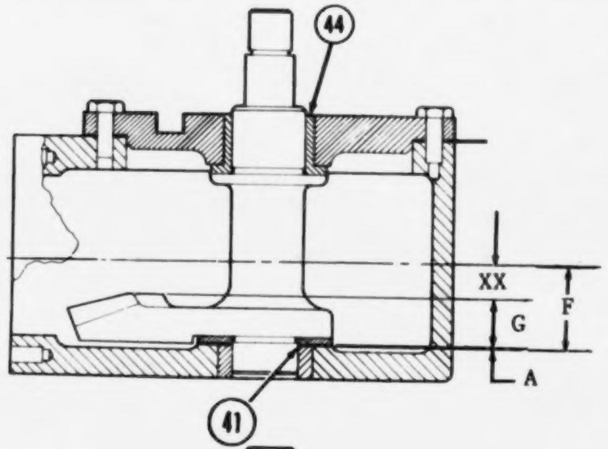
2 Using micrometer, measure distance B at several points around cover (38). Measurement should not vary. Install cover shims (39) between actuator housing (43) and cover (38) equal to dimension B plus 0.002 to 0.004 inch (0.05 to 0.10 mm). Cover shim (39) thickness as follows:

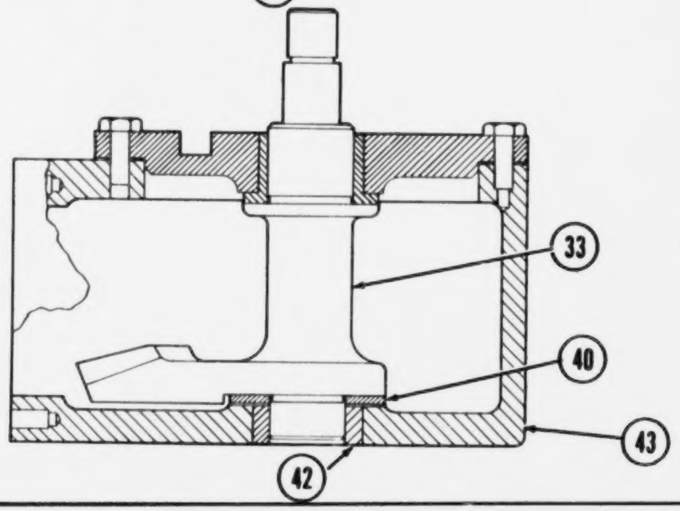
PART NUMBER	COVER SHIM THICKNESS
10895660	0.001 inch (0.02 mm)
10895661	0.002 inch (0.05 mm)
10895662	0.005 inch (0.12 mm)

MOUNT AND HOWITZER ASSEMBLY — Continued

4-17. ACTUATOR AND FOLLOWER ASSEMBLY — Continued

d. Assembly-Continued



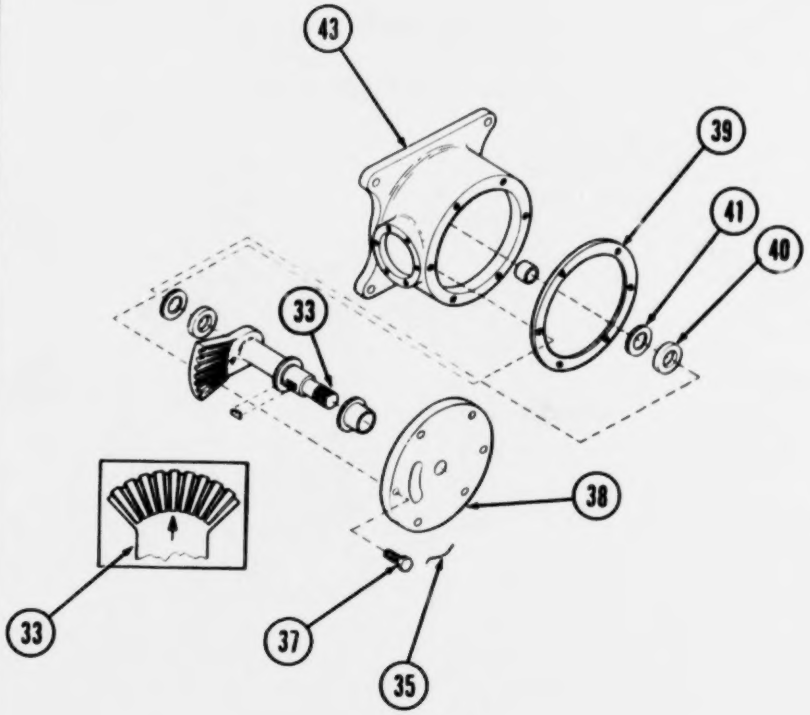


3 Determine dimension A of thrust bearing shim (41). Assemble thrust bearing (40) to sector gear (33) (outside actuator housing (44)). Measure dimension G.

4 Add dimension G to dimension XX (etched on sector gear (33)). Subtract sum of G and XX from F (smaller dimension etched on actuator housing.

Formula is as follows:
F - (G + XX) = dimension A, which is the required thrust bearing shim (41) thickness.

PART NUMBER	SHIM THICKNESS
10895663	.001 inch (0.02 mm)
10895664	.002 inch (0.05 mm)
10895665	.005 inch (0.12 mm)


43
39
41
40
33
38
33
37
35

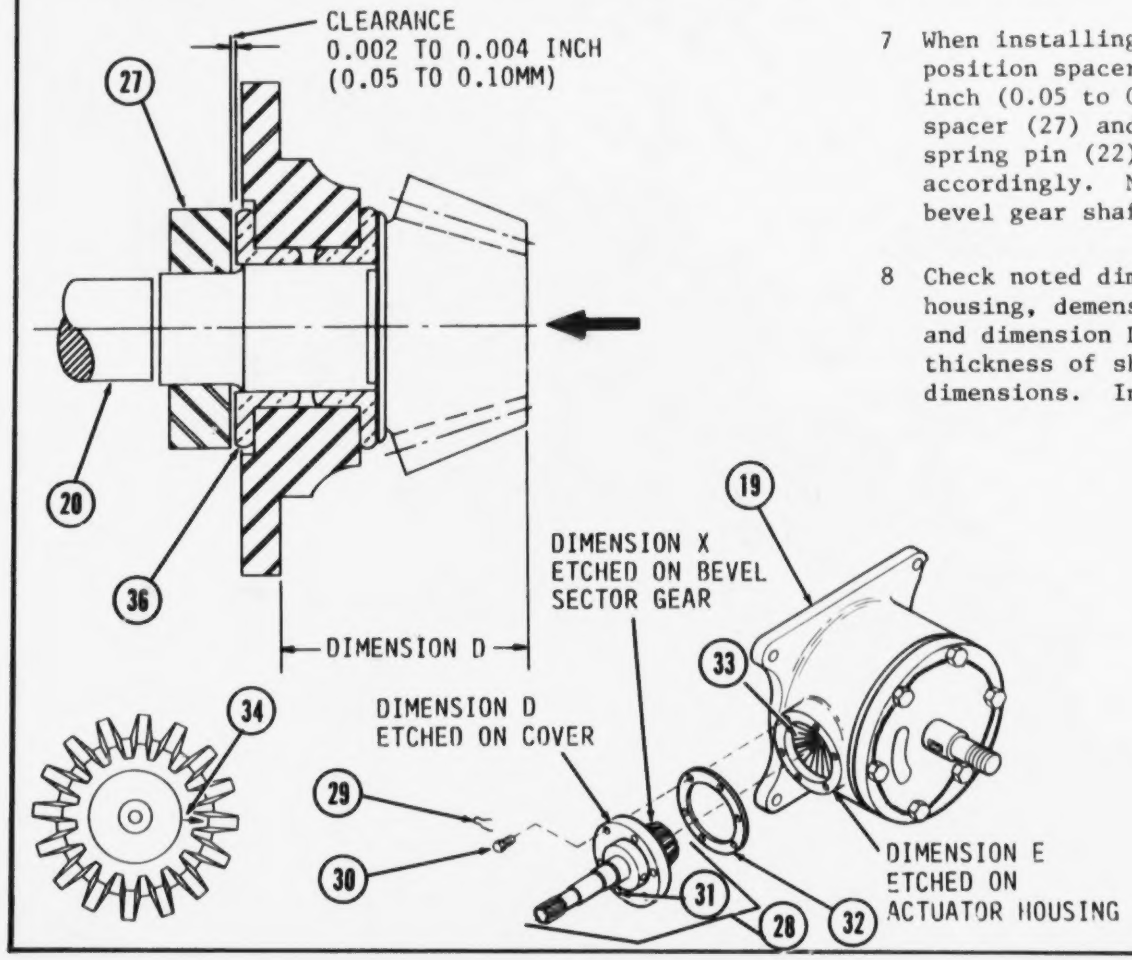
5 Install thrust bearing shim (41), thrust bearing (40), sector gear shaft (33), cover shim (39) and cover (38) into actuator housing (43).

6 Install six screws (37) and new lock wire (35).

MOUNT AND HOWITZER ASSEMBLY — Continued

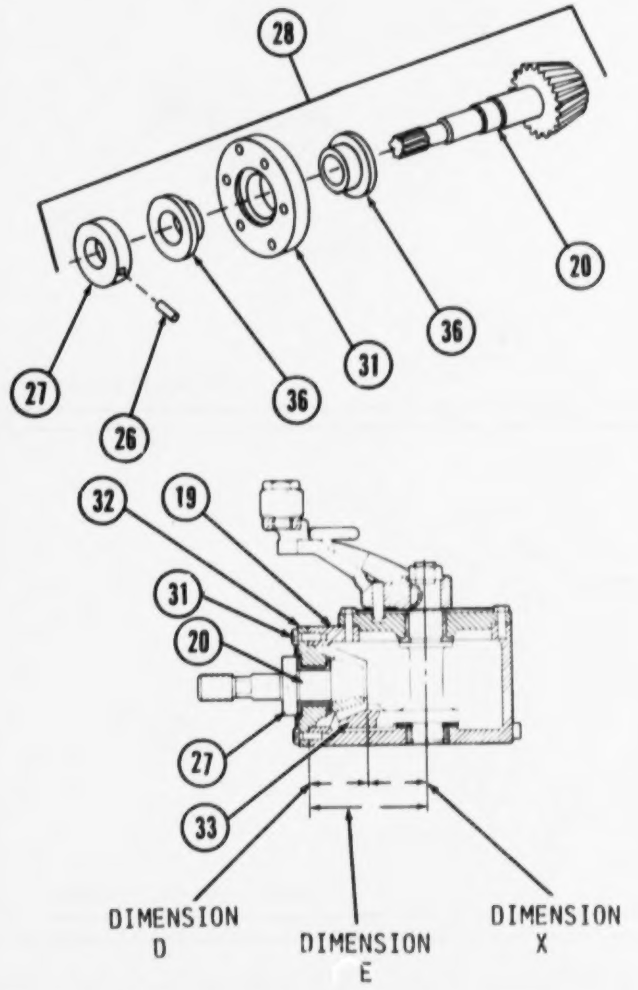
4-17. ACTUATOR AND FOLLOWER ASSEMBLY – Continued

d. Assembly-Continued


CLEARANCE
0.002 TO 0.004 INCH
(0.05 TO 0.10MM)
27
20
36
DIMENSION D
DIMENSION X
ETCHED ON BEVEL
SECTOR GEAR
19
33
34
DIMENSION D
ETCHED ON COVER
29
30
31
28
32
DIMENSION E
ETCHED ON
ACTUATOR HOUSING

7 When installing new bevel gear shaft (20) position spacer (27) to give 0.002 to 0.004 inch (0.05 to 0.10 mm) clearance between spacer (27) and sleeve bearing (36). Drill spring pin (22) (ref. page 4-234) hole accordingly. Note matching arrows (34) on bevel gear shaft (20) and sector gear (33).

8 Check noted dimension E etched on actuator housing, demension X etched on sector gear and dimension D etched on cover. Make sure thickness of shim (32) matches noted dimensions. Install shim (32).



NOTE

Backlash between gears should be 0.004 to 0.006 inch (0.10 to 0.15 mm). This is obtained by shimming cover as follows: add dimension D to dimension X. Subtract dimension E from sum. Remaining dimension is required shim. Shim parts are listed below.

PART NUMBER	SHIM THICKNESS
10895666	0.001 inch (0.02 mm)
10895667	0.002 inch (0.05 mm)
10895668	0.005 inch (0.12 mm)

COMBINE SHIMS AS NECESSARY.
(D + X) - E = REQUIRED SHIM.

9 Install two new sleeve bearings (35) if necessary. Make sure arrows match up exactly on sector gear (32) and bevel gear shaft (19) for proper alinement.

10 Install spacer (26) and spring pin (25) into bevel gear shaft assembly (27).

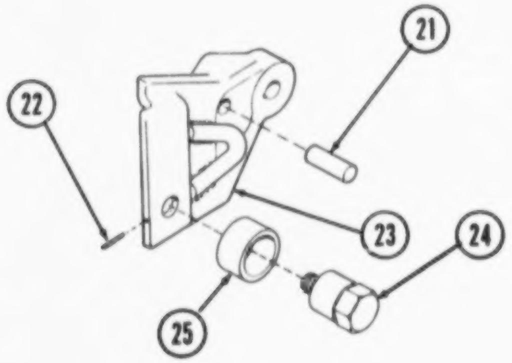
11 Install bevel gear shaft assembly (27) into actuator (18).

12 Install shim (32), if necessary. Install cover (31), six screws (30) and new lock wire (29) (ref. page 4-229).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-17. ACTUATOR AND FOLLOWER ASSEMBLY — Continued

d. Assembly-Continued



13 Install bearing (25) and shoulder bolt (24).

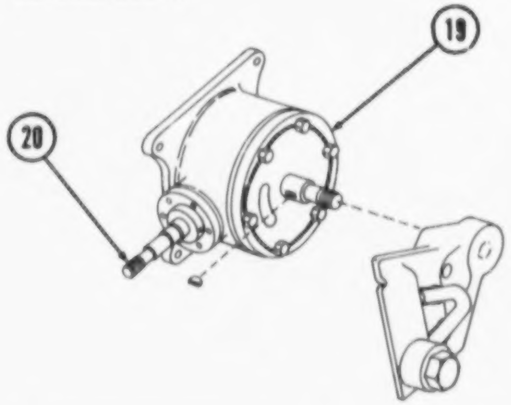
NOTE

When installing a new shoulder bolt or new cam lever on the actuator, it is necessary to drill spring pin hole in shoulder bolt and cam lever when assembling.

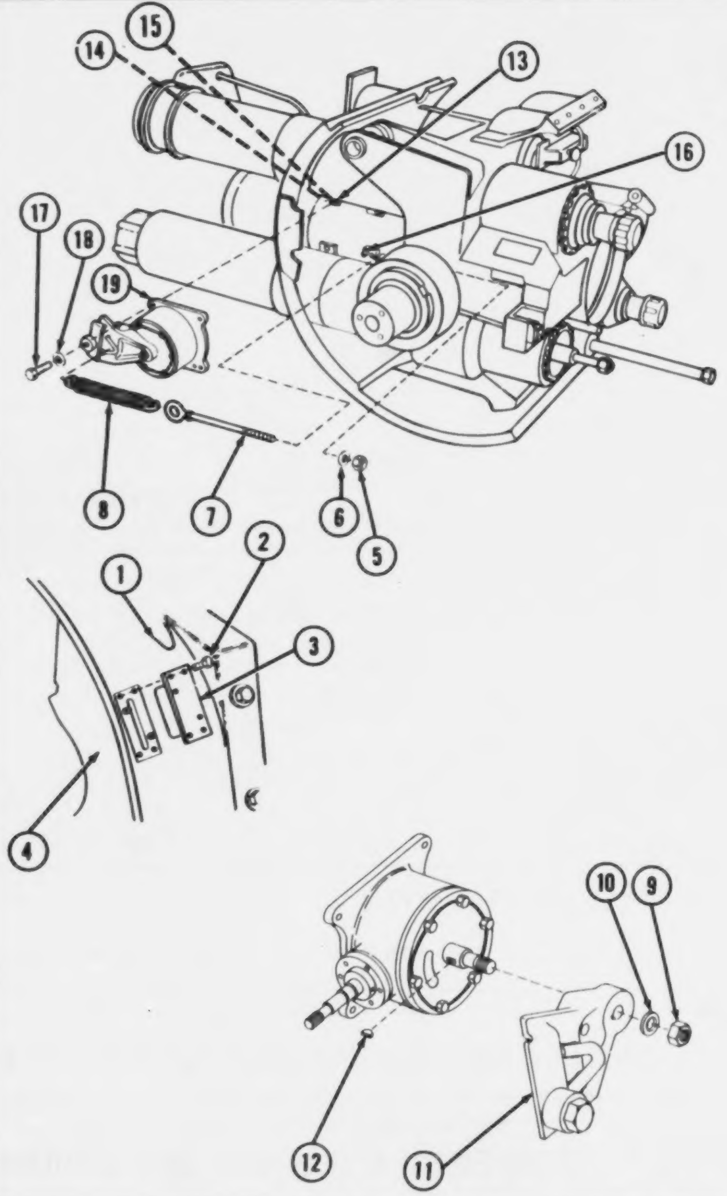
14 Install spring pin (22) into cam lever (23).

15 Install new limiting pin (21) if pin had been found to be excessively worn or damaged during disassembly.

e. Installation



1 Install actuator (19) and depress cannon. Move actuator (19) forward to engage bevel gear shaft (20) to universal joint.



NOTE

Install the mounting screws loosely, then install dowel pins and tighten mounting screws.

2 With cannon depressed, install three new lock washers (18), three screws (17) and lower rear dowel pin (16).

3 Elevate cannon. Install new lock washer (15) and front screw (14).

4 With cannon still elevated, tap in upper front dowel pin (13) in actuator (19).

5 Install woodruff key (12), cam lever assembly (11), new lock washer (10) and nut (9).

6 Install spring (8), eyebolt (7), flat washer (6) and nut (5).

7 Install follower (3), four screws (2) and new lock wire (1) into upper left front of trunion bracket assembly (4).

8 Install upper rotor.

9 Install weather cover (ref. page 8-6).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation
f. Servicing with High Pressure Nitrogen

INITIAL SET-UP

Materials/Parts
Hydraulic fluid (Item 10, App C)
Preformed packing
Adhesive (Item 3, App. C)
Sealing compound, grade C (Item 20, App. C)
Dry nitrogen, high pressure (Item 18, App. C)

Special Tools
Fire control purging and charging kit (Item 12, App. B)

Test Equipment
Pressure gage test rig

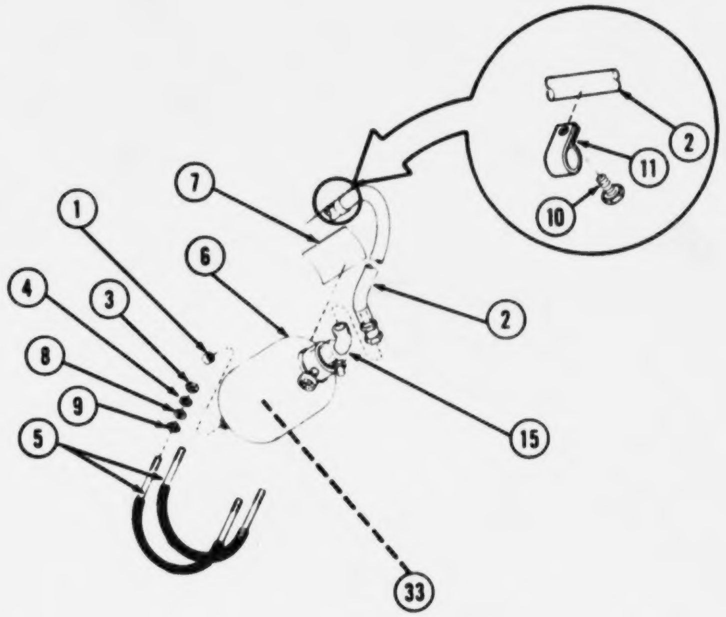
Personnel Required
2

a. Removal

WARNING

- Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.
- Dry nitrogen tanks are marked with one or two black bands at the top of the tank. Do not use tanks without black band. In charging accumulator replenisher, use dry nitrogen. Certain other gases will cause accumulator replenisher to explode, resulting in possible death or serious injury.
- Accumulator replenisher procedures can be performed while mount and cannon are installed in vehicle.

1 For discharging and draining of replenisher hydraulic system refer to TM 9-2350-311-20-2.



WARNING

Accumulator replenisher contains pressurized nitrogen. Do not disassemble until all pressure is relieved.

2 Remove accumulator nitrogen valve cap (1) and release nitrogen pressure from accumulator bag (33).

3 Disconnect hose assembly (2) at elbow (15).

WARNING

Weight of accumulator is 65 pounds (30 kg). A second person must support accumulator inside cab when installing to prevent injury to personnel.

4 Remove four self-locking nuts (3) and four washers (4) from two U-bolts (5) on right front of cab.

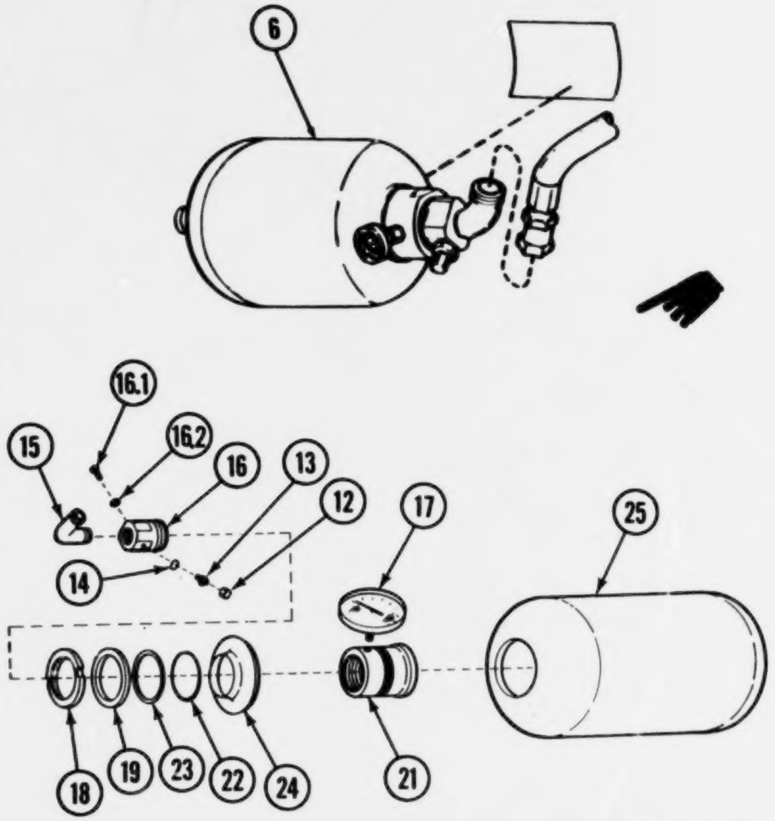
5 Remove two U-bolts (5), accumulator (6) and pad (7) from cab wall with four washers (8) and four inside nuts (9).

6 To remove hose assembly (2), remove six screws (10) from six clamps (11). Remove six clamps (11) from hose.

7 Unscrew hose assembly (2) and remove from manifold (not shown).

4-18. ACCUMULATOR REPLENISHER ASSEMBLY — Continued

b. Disassembly



1 Clamp accumulator (6) in a vise with padding to protect shell.

2 Remove valve cap (12), check valve (13) and preformed packing (14) in sequence from adapter (16). Discard preformed packing (14).

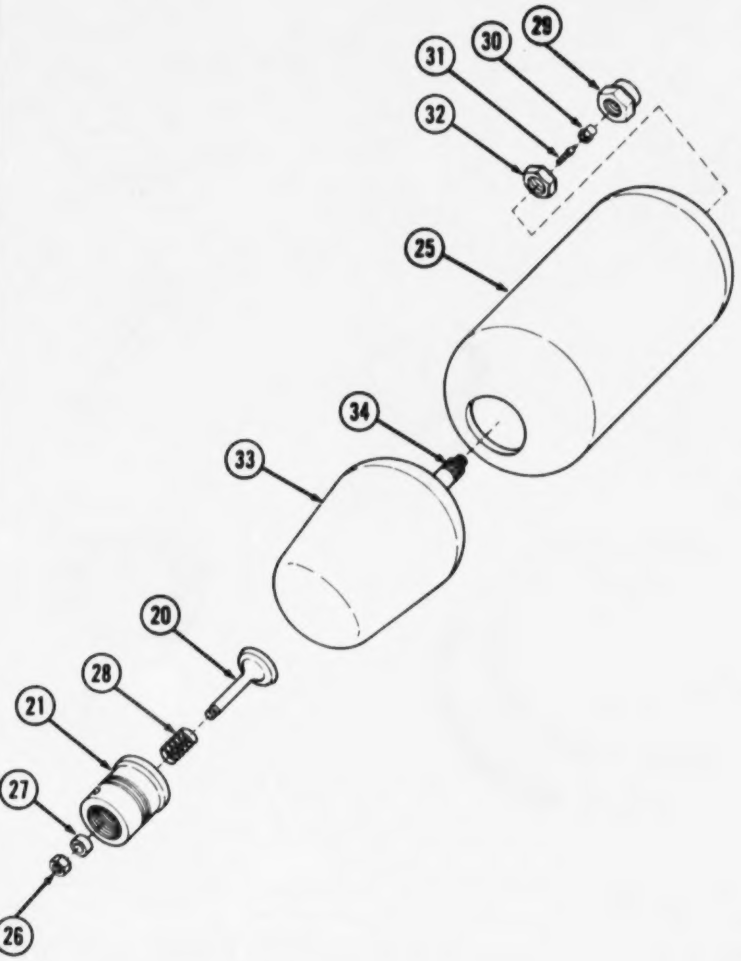
2.1 Remove plug (16.1) and preformed packing (16.2) from adapter (16). Discard preformed packing.

3 Remove elbow (15) and adapter (16) in sequence.

4 Remove pressure gage (17).

5 Remove nut (18), using spanner wrench .

6 Remove spacer ring (19).



7 Push poppet (20) and plug housing (21) into shell (25) with palm of hand.

NOTE

Retaining ring is split and is bonded into rubber. It must be folded to remove from shell.

8 Lift preformed packing (22), ring spacer (23) and retaining ring (24) out of shell (25). Discard preformed packing (22).

9 Remove poppet (20) and plug housing (21) from shell (25).

10 Remove nut (26), sleeve (27), spring (28) and poppet (20) from plug housing (21).

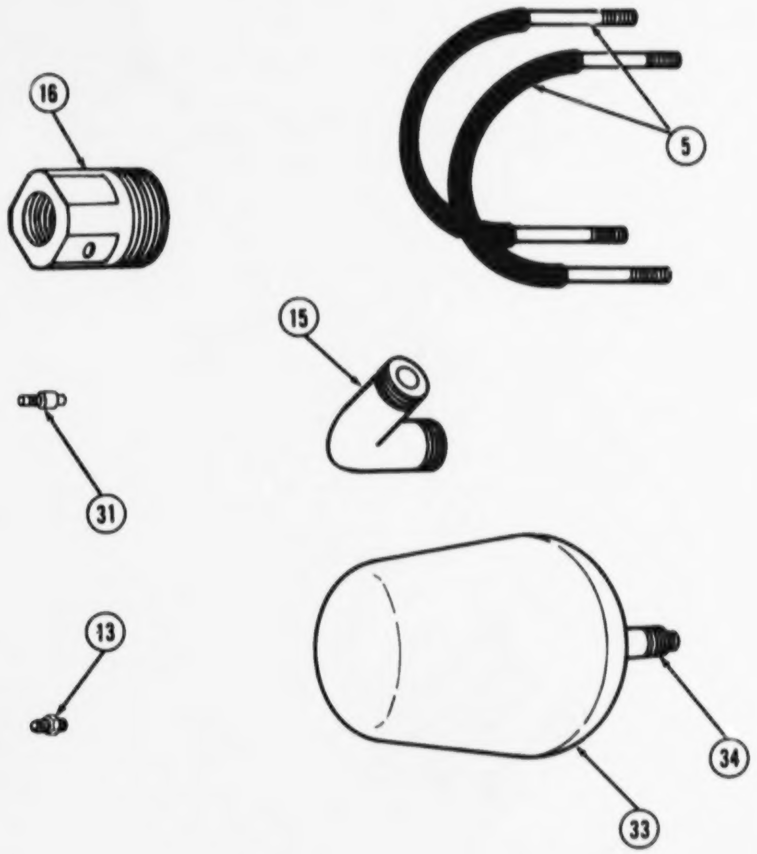
11 Remove protective cap (29), valve cap (30), valve core (31) and locknut (32).

12 Grasp accumulator bag (33) and gas valve (34) and compress to remove all gas. Withdraw from shell (25).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY — Continued

c. Inspection



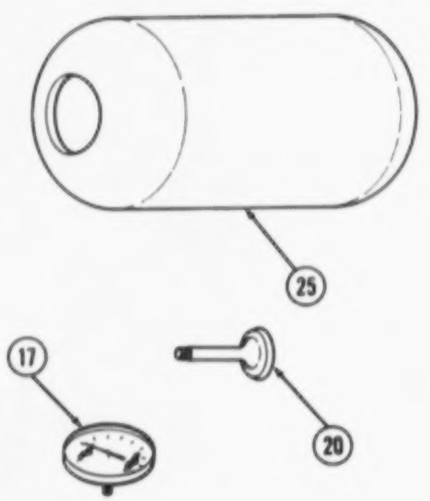
1 Inspect elbow (15). Replace if gouged or if threads are stripped.

2 Inspect adapter (16). Replace if surfaces are damaged and threads are stripped.

3 Inspect check valve (13). Replace if worn or damaged.

4 Inspect two U-bolts (5). Replace if bent or distorted or if threads are stripped.

5 Inflate accumulator bag (33) and submerge accumulator bag (33), gas valve (34) and valve core (31). Replace accumulator bag (33) if there are signs of leakage. Replace gas valve (34) if cracked or loose.



6 Inspect shell (25). Replace accumulator if cracked or distorted.

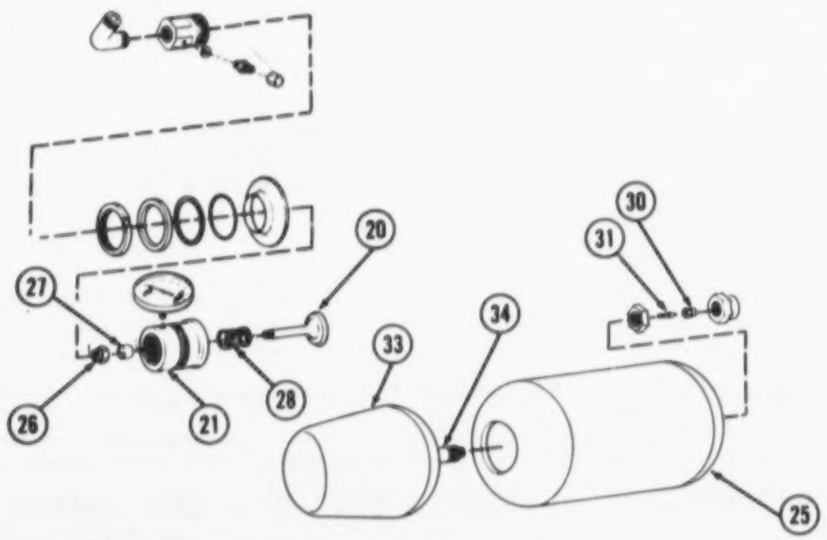
7 Inspect poppet (20). Replace if damaged.

8 Inspect pressure gage (17) for damage. Replace if necessary.

NOTE

For cold weather operation (40°F to -80°F) (-40°C to -62°C), use cold weather accumulator bag and gas valve assembly.

d. Assembly



1 Assemble poppet (20), spring (28), sleeve (27) and nut (26) into plug housing (21).

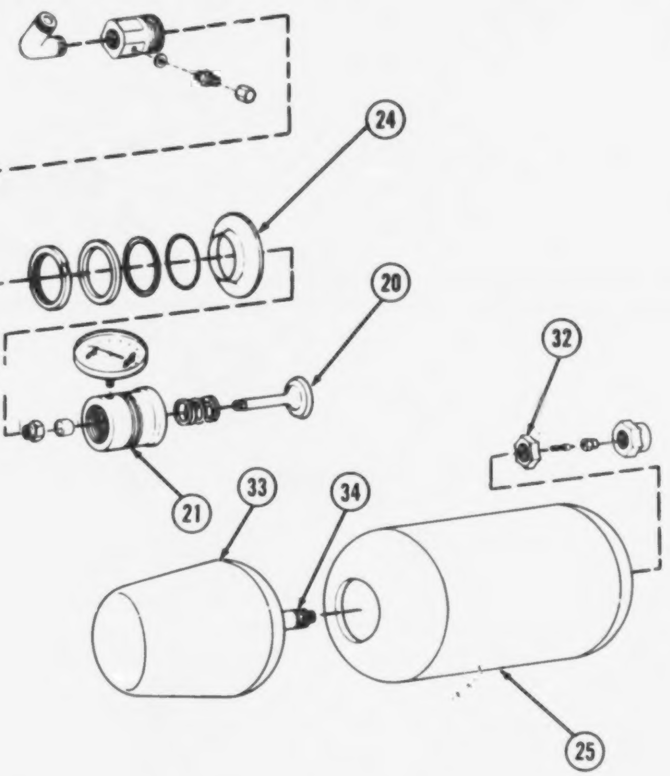
2 Pour a small amount of hydraulic fluid (Item 10, App. C) into shell as a cushioning fluid (heavy coating on interior of shell (25).

3 Depress accumulator bag (33) and gas valve (34). Install valve core (31) and valve cap (30).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY – Continued

d. Assembly-Continued

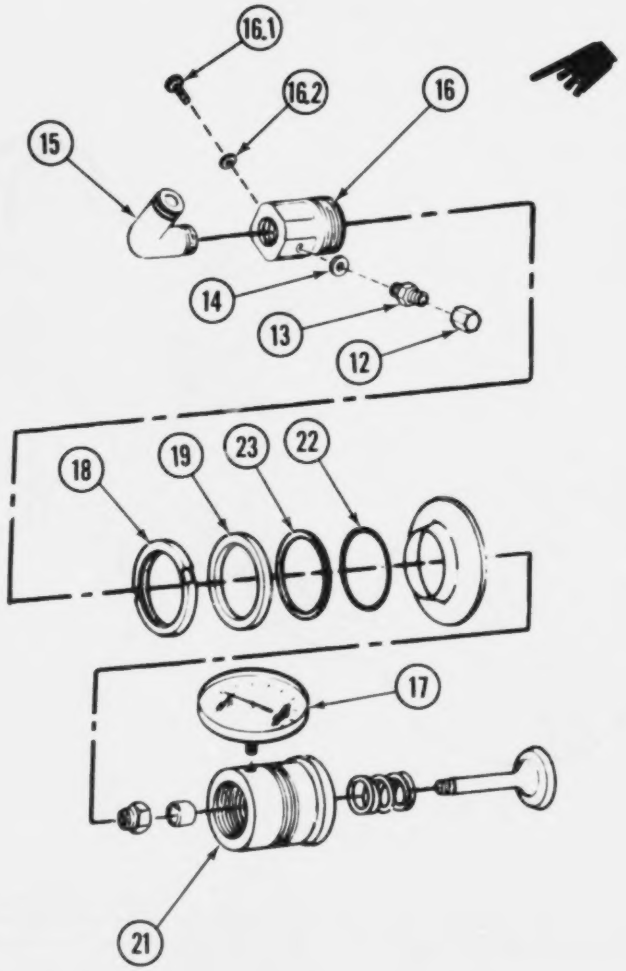


4 Fold accumulator bag (33) and gas valve (34) to enter shell with minimum friction. Guide gas valve (34) stem with hand through hole in wider end of shell (25).

5 Install locknut (32) securely.

6 Install poppet (20) and plug housing (21) into shell.

7 Place retaining ring (24) on plug housing (21) with small shoulder toward shell mount and fold to insert.



8 Place ring spacer (23) on plug housing (21) and install new preformed packing (22).

9 Withdraw plug housing (21) threaded portion through shell mouth. Pull until solidly seated and packing is squeezed.

10 Install spacer ring (19) on plug housing (21), then install nut (18). Tighten nut (18) securely.

11 Install pressure gage (17) on plug housing (21).

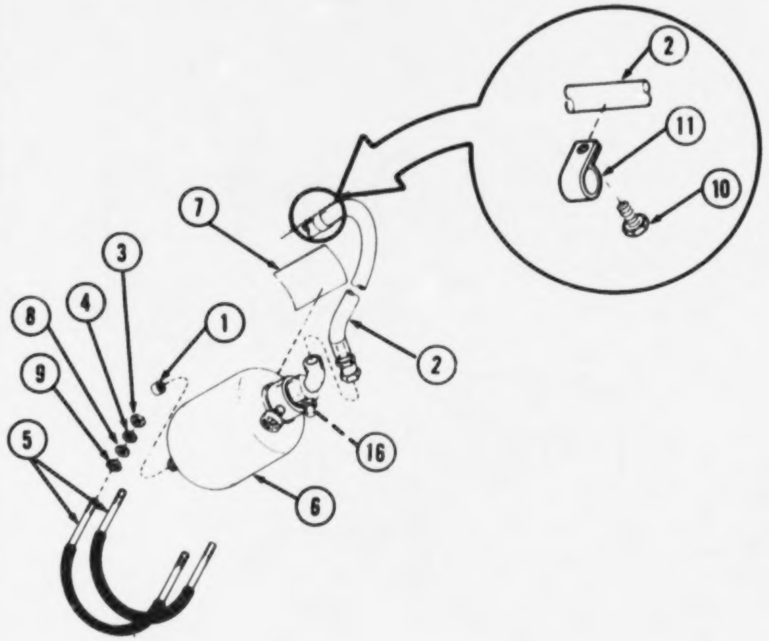
12 Install new preformed packing (14), check valve (13), cap (12) and elbow (15) onto adapter (16).

13 Install new preformed packing (16.2) and plug (16.1) onto adapter (16).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY — Continued

e. Installation



NOTE

- Accumulator replenisher assembly can be precharged with dry nitrogen before installation to cab. Before installing adapter (16) to housing (21) add additional oil to shell (25), approximately 1 gallon, and proceed to page 4-247.
- If accumulator replenisher assembly is to be precharged after installation proceed with step 1.

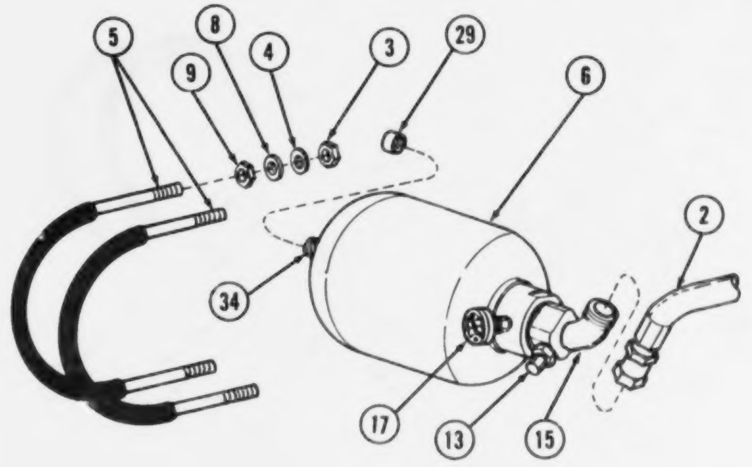
1 Screw adapter (16) into housing (21).

2 Attach six clamps (11) to hose assembly (2). Use sealing compound (Item 20, App. C) on shafts of six cap screws (10). Install six cap screws (10) to six clamps (11). Torque cap screws (10) to 9 lb-ft (12 N·m).

3 Apply adhesive (Item 3, App. C) to pad (7) and cab wall. Install pad (7) on cab wall.

WARNING

Weight of accumulator is 65 pounds (30 kilograms). A second person must support accumlator inside cab when installing to prevent injury to personnel.



4 Connect hose assembly (2) to elbow (15). Tighten swivel fitting.

NOTE

If not precharged before installation proceed with step 5.

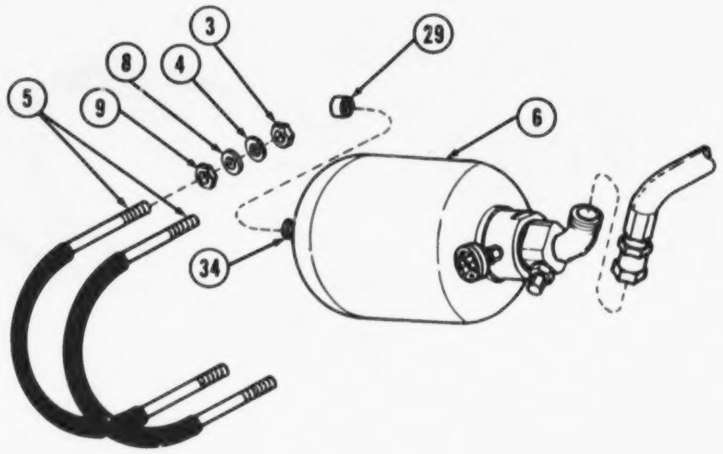
5 Inject enough hydraulic fluid (Item 10, App. C) into accumulator (6) through check valve (13) to provide fluid cushion. (Capacity is 2.5 gallons (9.5 l)).

6 Precharge accumulator (ref. page 4-247).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY — Continued

e. Installation-Continued



7 Install protective cap (29) on gas valve (34).

WARNING

Weight of accumulator is 65 pounds (30 kilograms). A second person must support accumulator inside cab when installing to prevent injury to personnel.

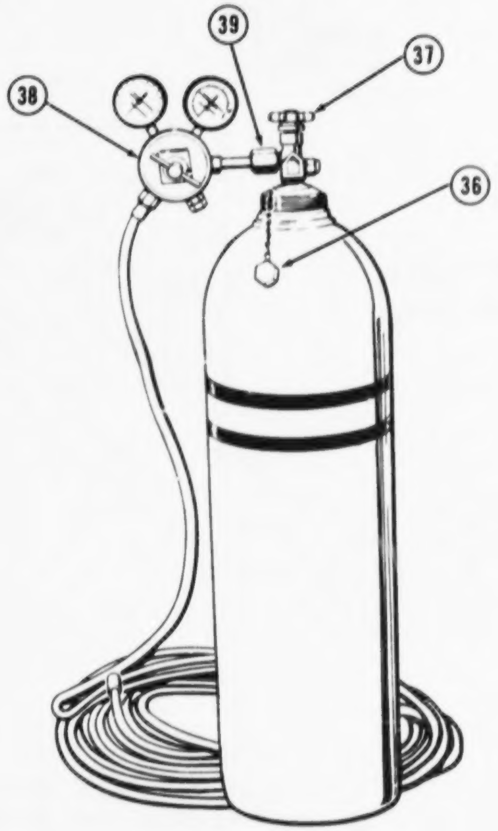
NOTE

Inside nuts and washers on U-bolts must not be in contact with cab wall until outside self-locking nuts have been torqued.

8 Install four inside nuts (9) and four washers (8). Tighten four inside nuts (9).

9 Install accumulator (6) and two U-bolts (5) to cab wall with four washers (4) and four self-locking nuts (3) on outside. Torque to 10-15 lb-ft (13-20 N·m).

f. Servicing with High Pressure Nitrogen



WARNING

Make sure charging cylinder contains dry nitrogen. Dry nitrogen tanks are marked with one or two black bands. Certain other gases can cause accumulator to explode, resulting in possible injury.

CAUTION

Under no circumstances exceed the pressures indicated in the following procedures to prevent damage to equipment.

NOTE

Fire control charging kit is used to charge accumulator replenisher assembly to obtain low pressure required.

1 To set up fire control charging equipment, remove protective cover (36) from valve (37).

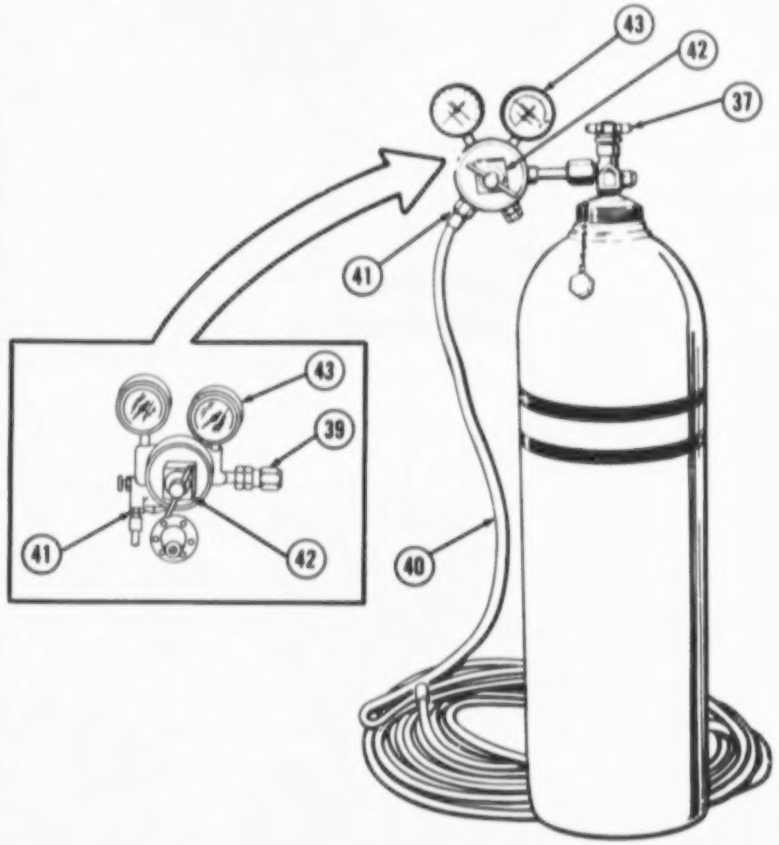
2 Open valve (37) slightly (to clear valve (37) of foreign materiel/dirt then close.

3 Attach regulator (38) securely using adapter (39).

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY — Continued

f. Servicing with High Pressure Nitrogen-Continued



NOTE

- Two regulator assemblies are currently used for purging and charging fire control materiel. The insert shows regulator 5580922, while the tank is shown with regulator 11729749.
- With regulator 11729749, an adapter must be used to connect hose assembly to low pressure port of regulator. Use a right or left-hand threaded 9/16 X 18 NF adapter, depending on thread requirements of the hose assembly coupling.

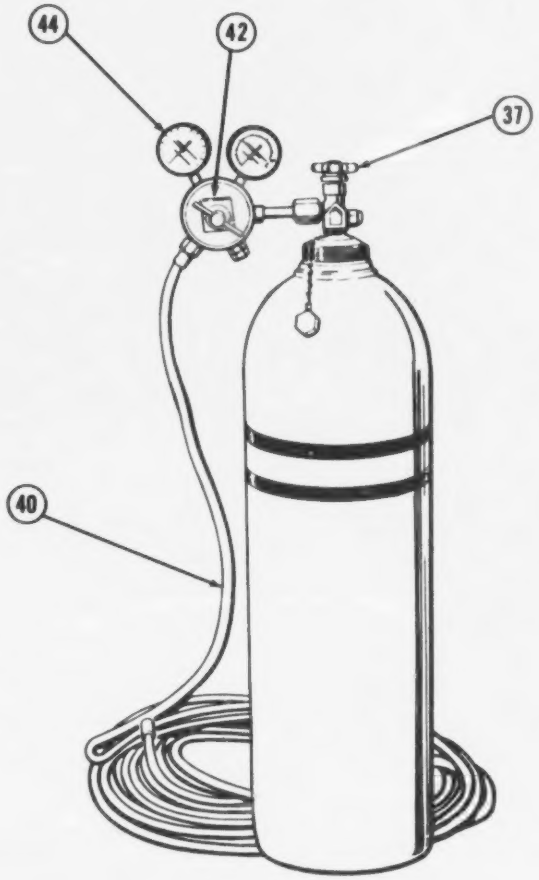
4 Attach hose assembly (40) to low pressure port (41).

5 Shut off regulator valve (42) by rotating counterclockwise.

6 Open valve (37) slowly. Adjust until maximum tank pressure registers on high pressure gage (43).

NOTE

If pressure indicated is less than 100 psi (690 kPa), replace tank.



7 Rotate regulator valve (42) slowly clockwise. (Rotate until approximately 5 psi (34 kPa) registers on low pressure gage (44)).

8 Check for blockage and eliminate if necessary.

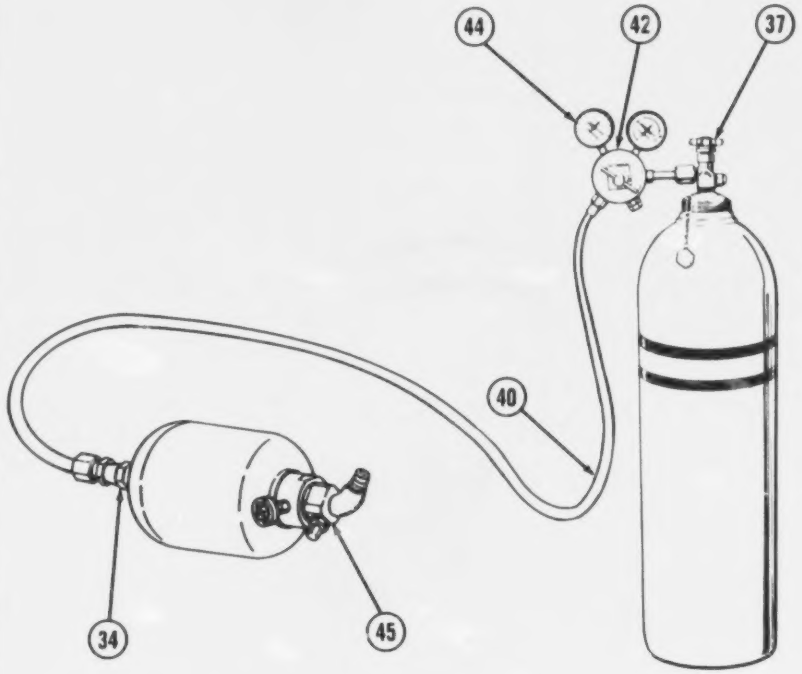
9 Close valve (37). Allow nitrogen to bleed from regulators and hose assembly (40).

10 Close regulator valve (42). Turn counterclockwise.

MOUNT AND HOWITZER ASSEMBLY — Continued

4-18. ACCUMULATOR REPLENISHER ASSEMBLY — Continued

f. Servicing with High Pressure Nitrogen-Continued



11 To charge accumulator replenisher, connect hose assembly (40) to filling valve (45), but do not tighten at this time.

12 Open valve (37) and regulator valve (42) slowly to purge hose assembly (40).

13 Close regulator valve (42) and tighten connection on filling valve (45) by rotating slowly clockwise.

14 Rotate regulator valve (42) until 7 to 8 psi (45-55 kPa) registers on low pressure gage (44).

15 Close regulator valve (42) and disconnect hose at gas valve (34). Apply soap suds to filling valve (45), checking for leaks.

CHAPTER 5 CAB HYDRAULICS

GENERAL

This chapter illustrates and describes the maintenance of the cab hydraulic system, which supplies and controls fluid power to operate the howitzer elevating, cab traversing and projectile rammer systems.

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CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts

- Preformed packings
- Gaskets
- Shims
- Hydraulic fluid (Item 10, App. C)
- Lubricating oil (Item 11, App. C)
- Lock washers

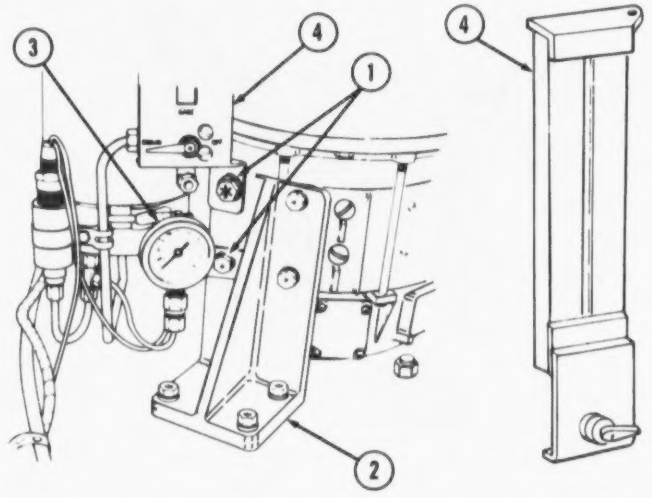
Special Tools

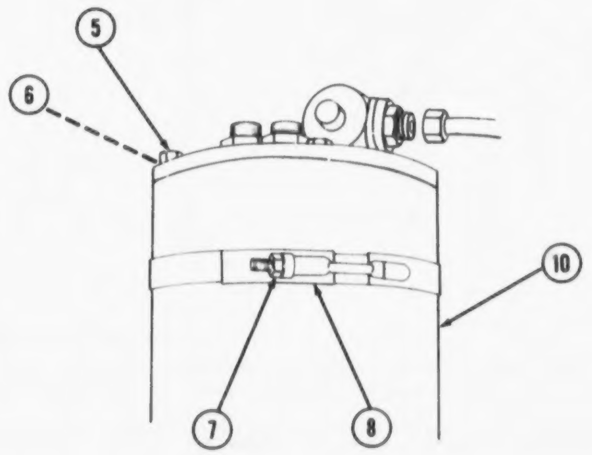
- Hoist
- Sling assembly, powerpack (Item 4, App. B)
- Special socket wrench (Item 7, App. B)

Personnel Required

2

a. Removal





1 Relieve hydraulic system pressure and drain hydraulic fluid (ref. TM 9-2350-311-20-2).

2 Disconnect lines and fittings from power pack to pressure switch and gages (ref. TM 9-2350-311-20-2).

NOTE

Step 3 applies to M109A2/M109A3 howitzers only.

3 Disconnect lines and fittings from cab to power pack (10) (ref. TM 9-2350-311-20-2).

NOTE

Steps 3.1 and 3.2 apply to M109A4 howitzers only.

3.1 Disconnect lines and fittings from hydraulic filters (ref. TM 9-2350-311-20-2).

3.2 Disconnect lines and fittings from hygroscopic breather and air line filter (ref. TM 9-2350-311-20-2).

4 Remove two screws (1) at power pack support (2). This action also disconnects pressure gage (3) and sight gage (4).

5 Remove bolt (5), lock washer (6) and sight gage (4) from top of power pack (10).

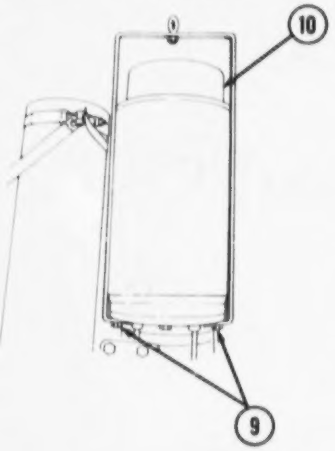
6 Install lock washer (6) and bolt (5) to top of power pack (10).

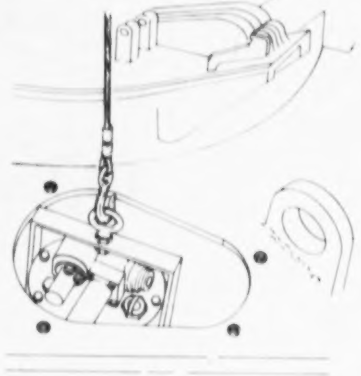
7 Remove hex nut (7) and power pack mounting clamp (8).

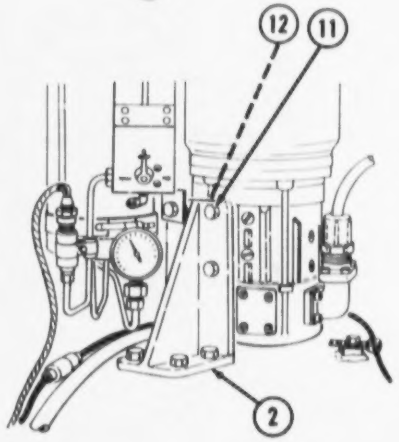
CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT – Continued

a. Removal-Continued







8 Remove two screws (9) at base of power pack (10).

9 Position power pack sling assembly (Item 4, App. B) over power pack (10).

10 Secure power pack sling assembly (Item 4, App. B) over power pack (10) with two screws (9).

11 Attach hoist. Take up slack in hoist cable.

12 Make sure weight of power pack (10) is supported by hoist. Remove two screws (11) and two lock washers (12) from power pack support (2). Discard lock washers (12).

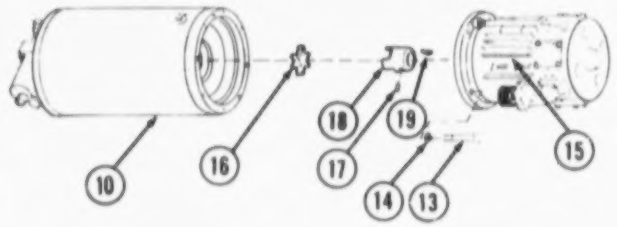
13 Remove power pack (10) from cab by lifting out through access hole.

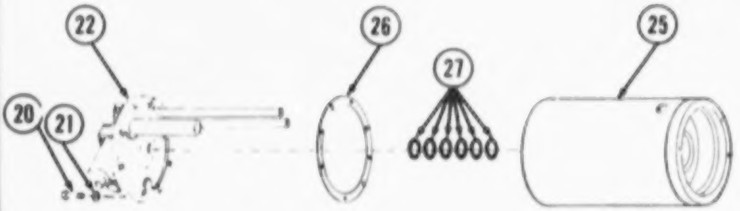
NOTE

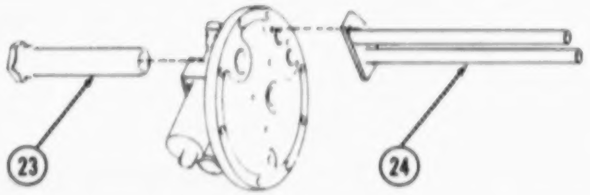
After removal, lay power pack on a solid surface, being careful not to bump or damage the solenoid or valve.

14 Remove hoist and power pack sling assembly from power pack (10).

b. Disassembly







NOTE

Filter assembly has been modified to a body assembly in M109A4 howitzers.

1 Remove four screws (13), four lock washers (14) and electric motor (15) from power pack (10). Discard lock washers (14).

2 Remove flexible insert (16).

3 Remove setscrew (17) from lower coupling half (18).

4 Remove lower coupling half (18) and key (19) from motor shaft of electric motor (15).

5 Remove eight bolts (20) and eight lock washers (21). Discard eight lock washers (21).

6 Separate and remove cover assembly (22) with attached strainer (23) and drain tube assembly (24) from reservoir, filter assembly/body assembly, pump and motor mount group (25). Refer to pages 5-17 and 5-22 for disassembly and assembly of cover assembly (22).

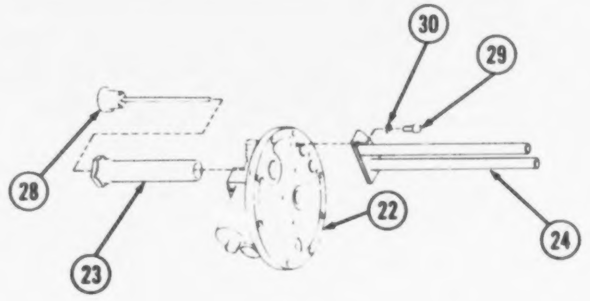
7 Remove and discard gasket (26).

8 Remove shims (27). Tie shims (27) together and save for assembly.

CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT — Continued

b. Disassembly-Continued

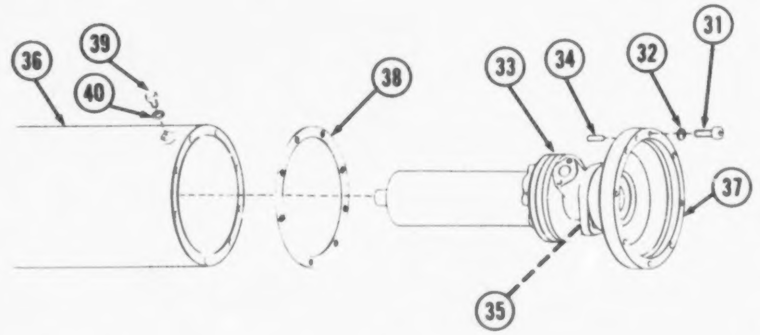


9 Withdraw fluid level gage (28).

10 Unscrew and remove strainer (23) using special socket wrench (Item 7, App. B).

11 Remove three screws (29) and three lock washers (30) from cover assembly (22) with attached drain tube assembly (24). Discard lock washers (30).

12 Remove drain tube assembly (24).

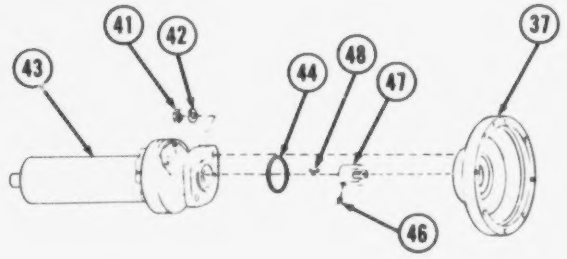


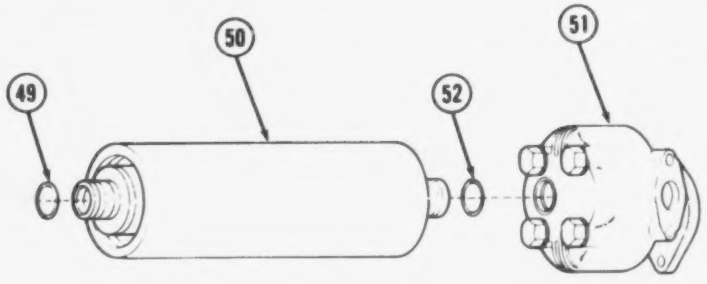
13 Remove four socket head cap screws (31) and four lock washers (32), securing pump, filter assembly/body assembly and motor mount group (33) with two pins (34) and two plain studs (35) from reservoir (36). Tap motor mount (37) lightly with plastic head mallet to separate. Discard lock washers (32).

14 Remove and discard gasket (38).

15 Remove plug (39) from reservoir (36).

16 Remove and discard preformed packing (40).





17 Remove two nuts (41), two lock washers (42) and pump and filter assembly/body assembly group (43) from motor mount (37). Discard lock washers (42).

18 Remove and discard preformed packing (44).

19 Remove setscrew (46) from upper coupling half (47).

20 Remove upper coupling half (47) and key (48) from pump and filter assembly/body assembly group (43).

21 Remove and discard preformed packing (49) from filter assembly/body assembly (50).

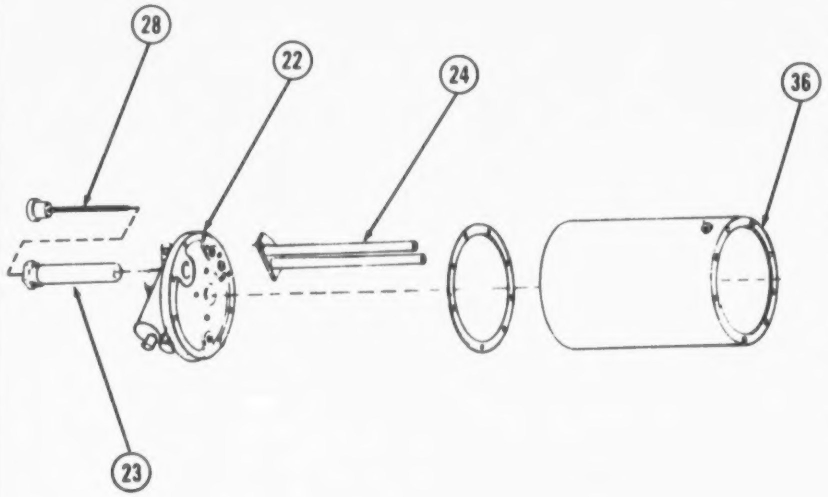
22 Separate filter assembly/body assembly (50) from pump (51).

23 Remove and discard preformed packing (52) from filter assembly/body assembly (50).

CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT — Continued

c. Inspection and Repair



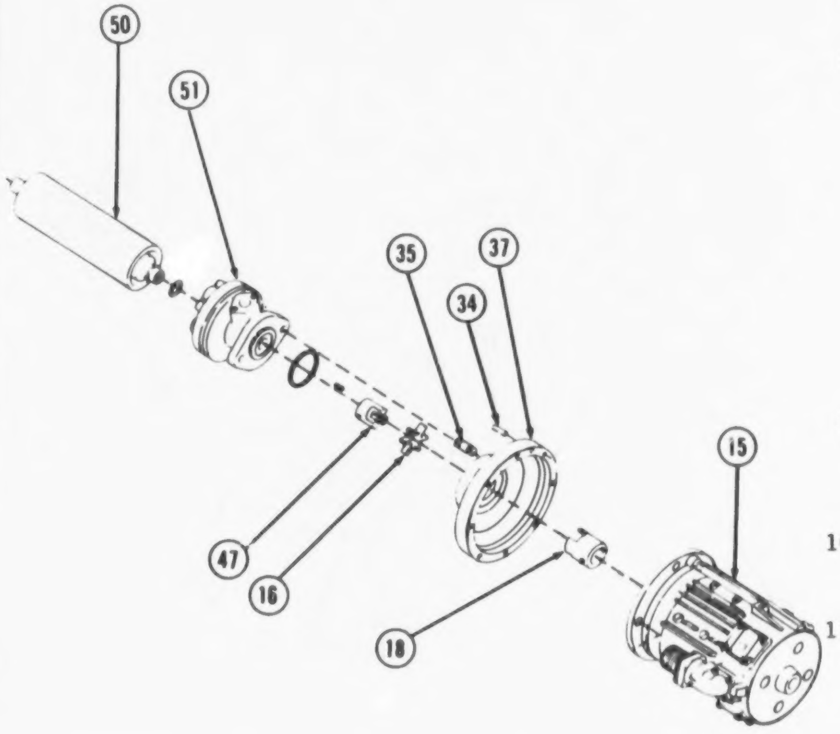
1 Inspect fluid level gage (28). Replace if bent or distorted. If seal on fluid level gage (M109A4 only) is damaged, replace seal.

2 Inspect strainer (23). Replace if cut or torn.

3 Inspect drain tube assembly (24). If soldered connections are damaged, repair or replace.

4 Inspect reservoir (36). Replace if cracked or if end surfaces are rough or distorted.

5 Inspect upper coupling half (47), flexible insert (16), and lower coupling half (18). Replace parts that are cracked, distorted or worn.



6 Inspect motor mount (37). Replace if cracked, distorted or damaged.

7 Inspect and test electric motor (15).

8 Test pump (51). Replace pump (51) if defective.

NOTE

Always replace filter element in M109A2/M109A3 howitzers whenever inspection of filter assembly (50) is made (ref. page 5-28). The M109A4 howitzer has eliminated the internal filter element.

9 Inspect filter assembly/body assembly (50) and replace if housing is bent, crushed, distorted or damaged.

10 Inspect cover assembly (22) (ref. page 5-21).

11 Inspect two plain studs (35) and two pins (34). Replace if bent, distorted, cracked or damaged.

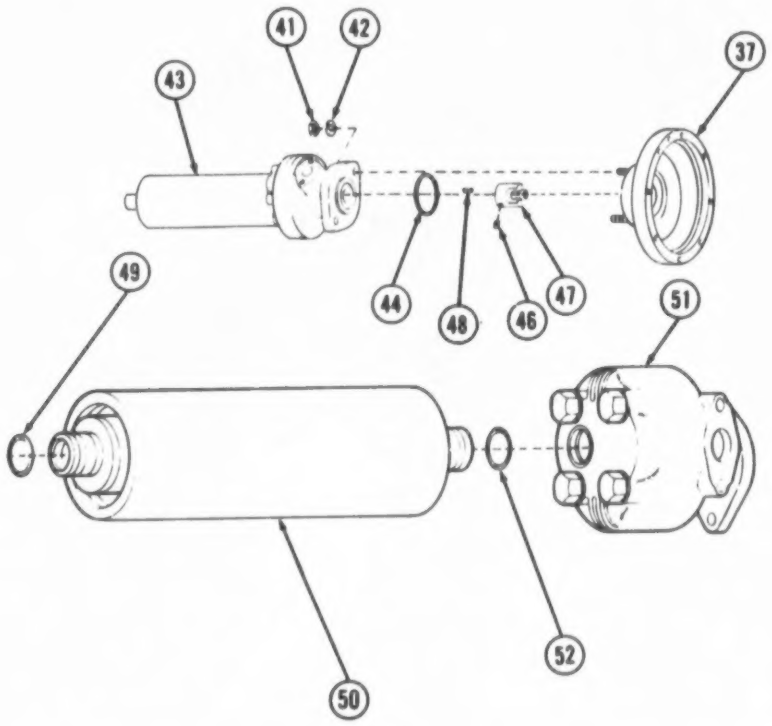
NOTE

Torque studs to 25 lb-ft (34 N·m) if replaced.

CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT — Continued

d. Assembly



NOTE

All parts and inside surfaces must be free of contaminants during assembly.

1 Install new preformed packing (52) in filter assembly/body assembly (50).

2 Install pump (51) to filter assembly/body assembly (50).

3 Install new preformed packing (49) in filter assembly/body assembly (50).

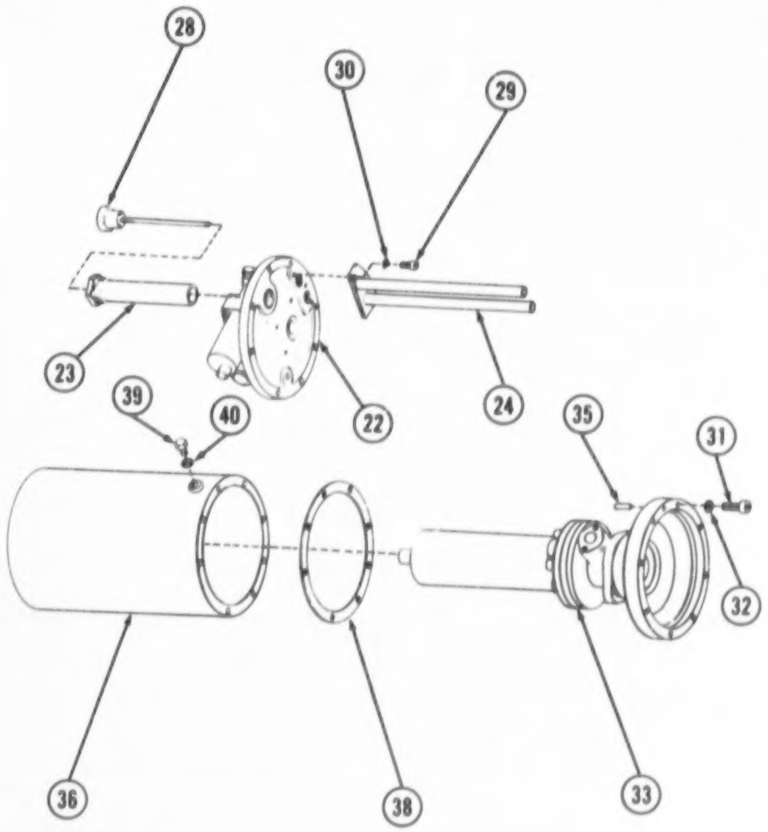
4 Install setscrew (46), key (48) and upper coupling half (47) on pump shaft.

5 Install new preformed packing (44).

CAUTION

Before installing, flush new filter assembly in power pack with hydraulic fluid (Item 10, App. C).

6 Install pump and filter assembly/body assembly group (43) to motor mount (37) with two new lock washers (42) and two nuts (41). Torque nuts (41) to 25 lb-ft (34 N·m).



7 Install new preformed packing (40).

8 Install plug (39) in reservoir (36).

9 Install new gasket (38).

NOTE

Lubricate threads of four socket head cap screws with clean lubricating oil (Item 11, App. C) before installation.

10 Install pump, filter assembly/body assembly and motor mount group (33), four new lock washers (32), and four socket head cap screws (31) to reservoir (36). Torque four cap screws (31) to 20-25 ft-lb (27-34 N·m).

11 Install drain tube assembly (24) on cover assembly (22).

12 Install three new lock washers (30) and three screws (29) to cover assembly (22) with attached drain tube assembly (24).

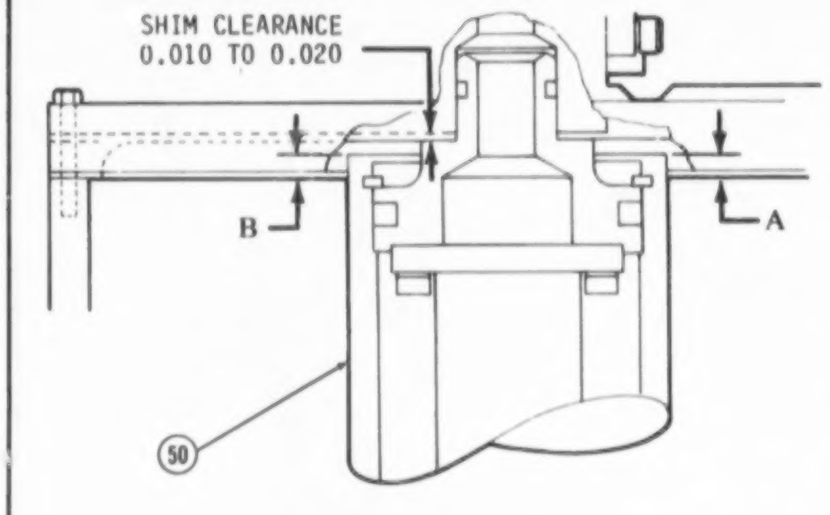
13 Insert strainer (23) and screw in until seated.

14 Insert fluid level gage (28).

CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT – Continued

d. Assembly-Continued

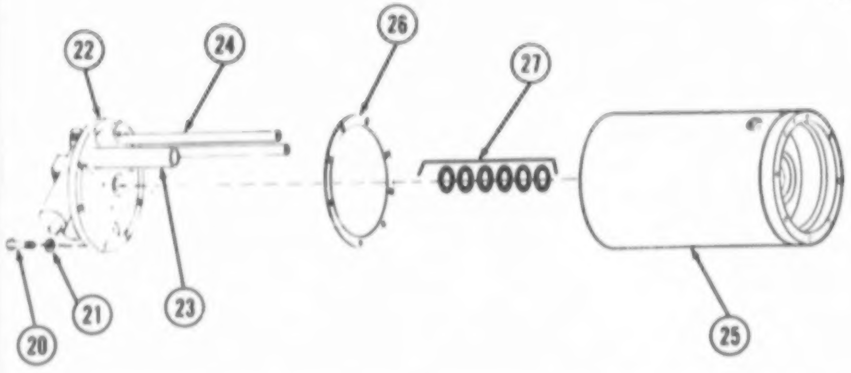


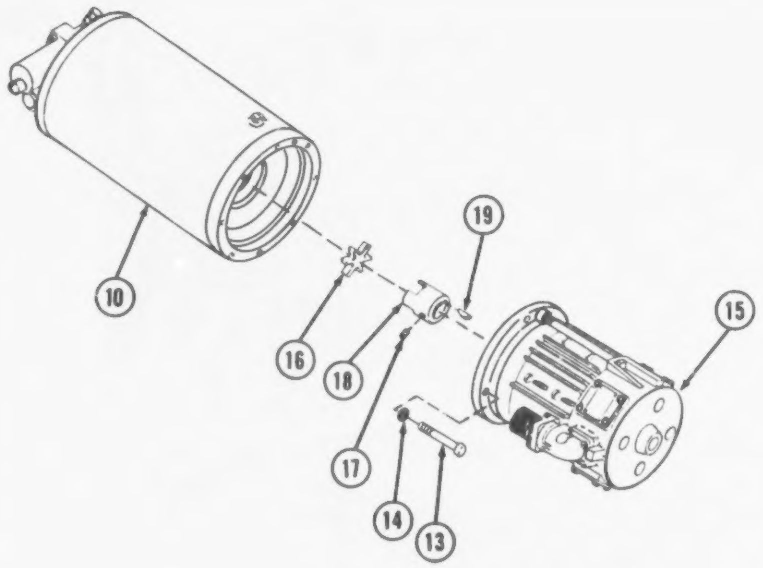
15 Install shims (27) saved during disassembly. Apply 60 to 100 psi (414 to 690 kPa) to filter assembly/body assembly (50) and shim as required to obtain a clearance of 0.010 to 0.020 inch (0.25 to 0.5 mm). Measure distances A and B. The shim thickness = A-B-0.0156 inch.

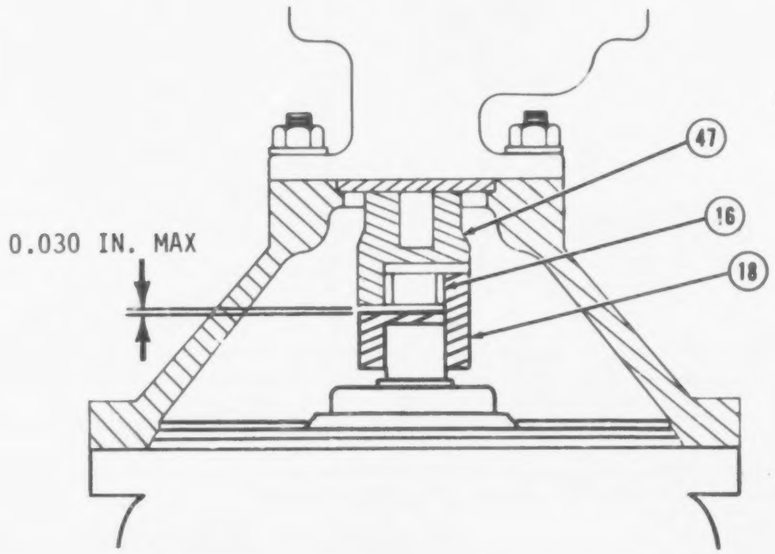
16 Install new gasket (26).

17 Assemble reservoir, filter assembly/body assembly, pump and motor mount group (25) to cover assembly (22) with attached drain tube assembly (24) and strainer (23).

18 Install eight new lock washers (21) and eight bolts (20).







19 Place flexible insert (16) in position in upper coupling half (47).

20 Install key (19), setscrew (17) and lower coupling half (18) on motor shaft of electric motor (15).

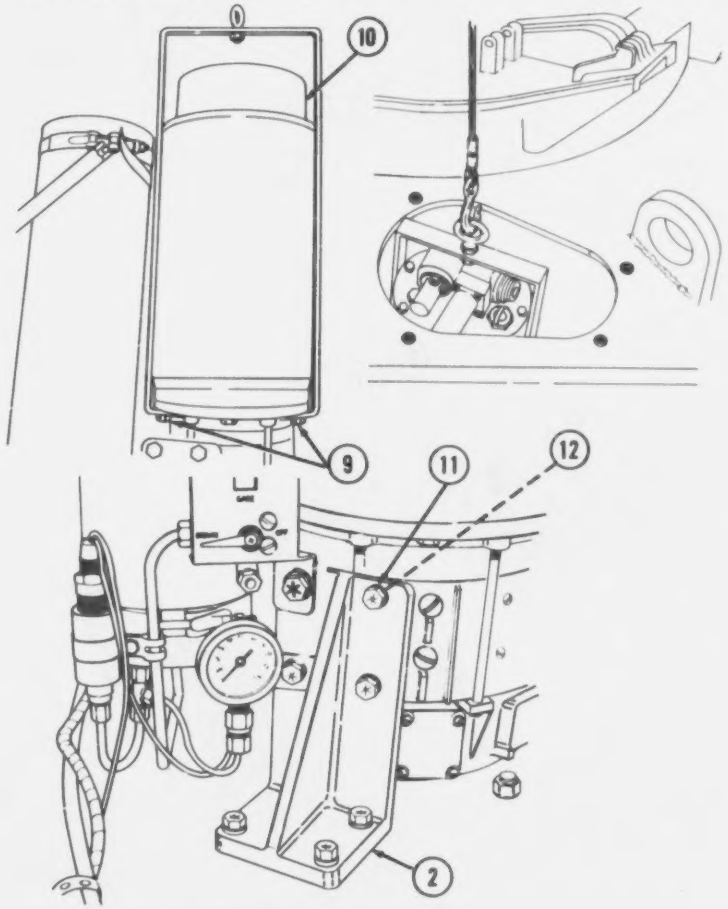
21 Adjust upper coupling half (47) and lower coupling half (18) to obtain 0.030 inch (0.8 mm) clearance between faces.

22 Install electric motor (15), four new lock washers (14) and four screws (13) to power pack (10). Torque screws (13) to 20-25 lb-ft (27-34 N·m).

CAB HYDRAULICS — Continued

5-1. POWER PACK, MOTOR AND MOUNT – Continued

e. Installation



1 Position power pack sling assembly (Item 4, App. B) over power pack (10).

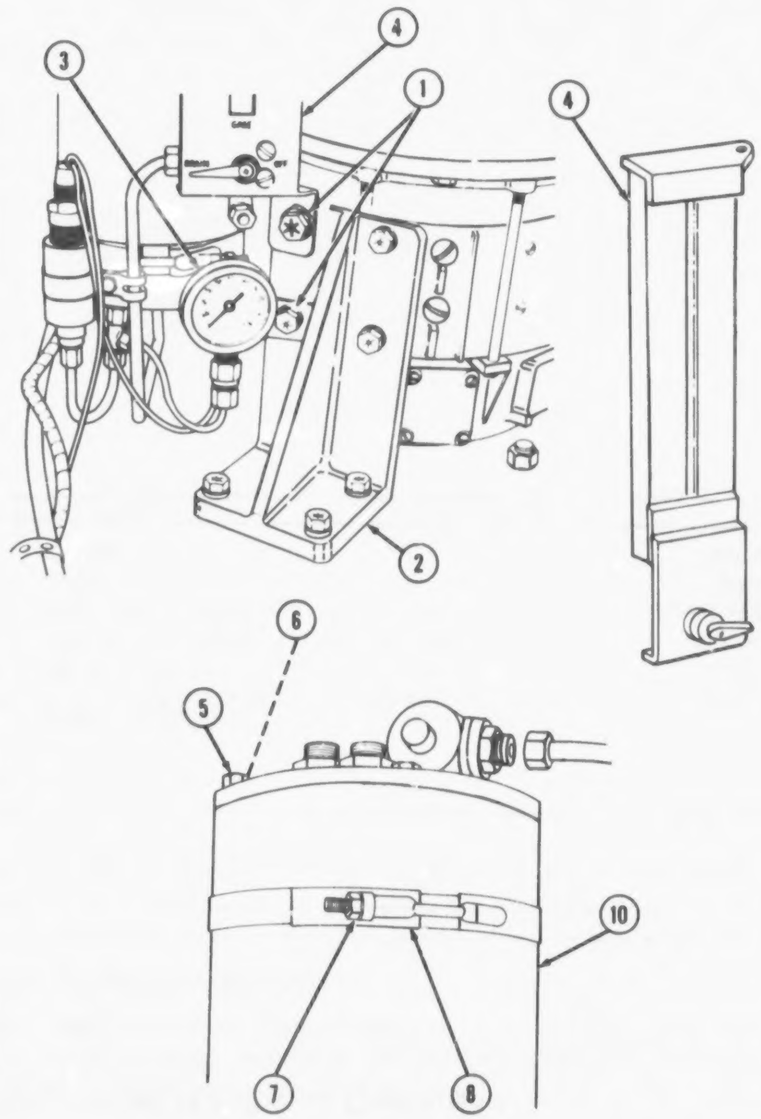
2 Secure power pack sling assembly to power pack (10) with two screws (9).

3 Attach hoist and take up slack in cable.

4 Lower power pack (10) through access hole into cab. Be careful not to strike or damage the solenoid or valve.

5 Make sure weight of power pack (10) is supported by hoist. Secure power pack (10) to power pack support (2) with two new lock washers (12) and two screws (11).

6 Remove hoist and power pack sling assembly from power pack (10).



7 Install power pack mounting clamp (8) and hex nut (7).

8 Remove bolt (5) and lock washer (6) at top of power pack (10). Discard lock washer (6).

9 Install sight gage (4) and secure at top of power pack (10) with new lock washer (6) and bolt (5).

10 Install pressure gage (3) and lower end of sight gage (4) to power pack support (2) with two screws (1).

NOTE

Steps 10.1 and 10.2 apply to M109A4 howitzers only.

10.1 Connect lines and fittings from hydraulic filters (ref. TM 9-2350-311-20-2).

10.2 Connect lines and fittings from hygroscopic breather and air line filter (ref. TM 9-2350-311-20-2).

NOTE

Step 11 applies to M109A2/M109A3 howitzers only.

11 Connect lines and fittings from cab to power pack (10) (ref. TM 9-2350-311-20-2).

12 Connect lines and fittings from power pack (10) to pressure switch and gages (ref. TM 9-2350-311-20-2).

13 Fill hydraulic system and check level (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

5-2. COVER ASSEMBLY

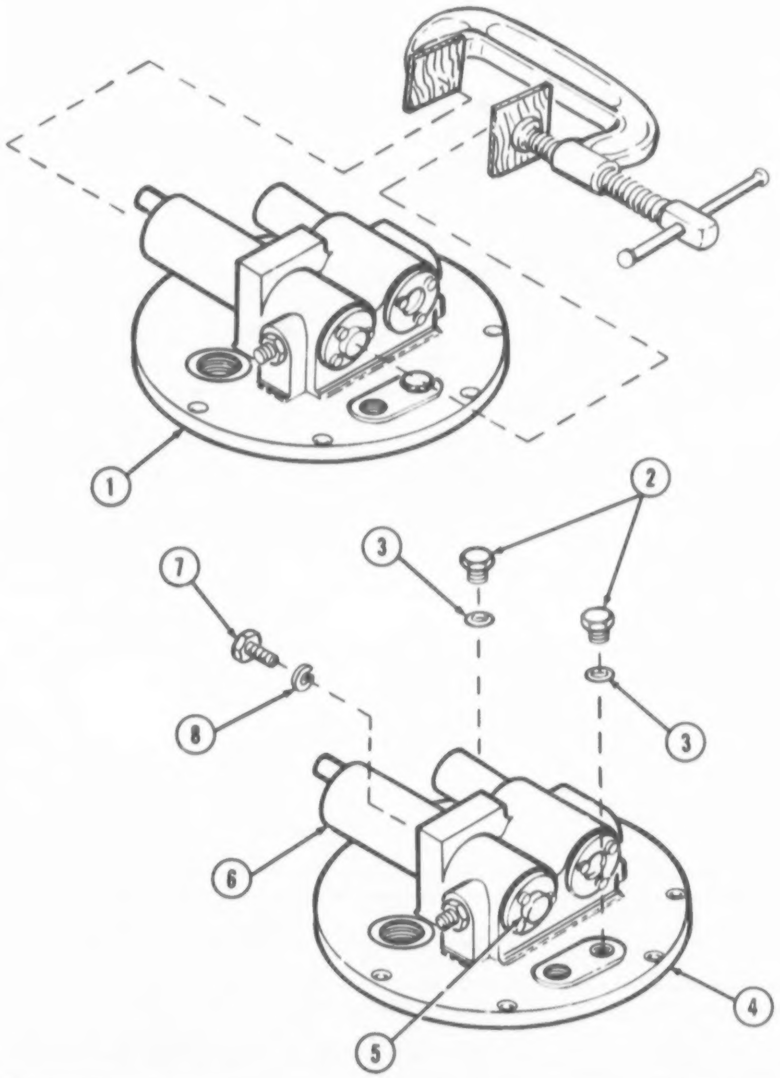
This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts

Power valve repair parts kit, P/N 10914109
Hydraulic fluid (Item 10, App. C)
Preformed packings
Seals
Gaskets
Spring seat
Flat washer
Inner spring
Large spring
Spring
Lock washers

a. Disassembly



1 Remove cover assembly (1) (ref. page 5-5).

2 Place cover assembly (1) on a solid work surface.

3 Remove two plugs (2) and two preformed packings (3) from cover (4). Discard two preformed packings (3).

4 Place two suitably-sized blocks of wood on the faces of power valve section (5) and solenoid (6).

5 Place "C"-clamp over ends of two wood blocks on power valve section (5) and solenoid (6) to restrain spring-loaded parts during disassembly.

WARNING

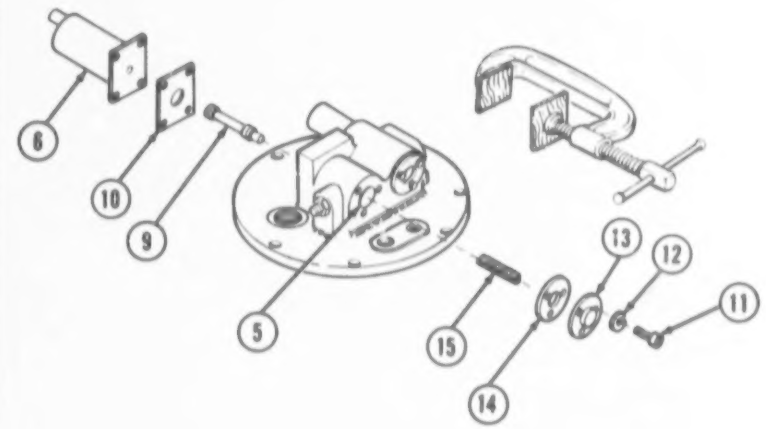
Remove cap screws with care, as they retain a spring-loaded spool within the solenoid.

6 Remove four socket head cap screws (7) and four lock washers (8). Discard four lock washers (8).

CAB HYDRAULICS — Continued

5-2. COVER ASSEMBLY — Continued

a. Disassembly-Continued



7 Unscrew "C"-clamp slowly, allowing internal spring in solenoid (6) to expand. Support solenoid (6) during this step. Remove "C"-clamp (6) and two wood blocks when all spring preload is released.

8 Remove solenoid (6) with care.

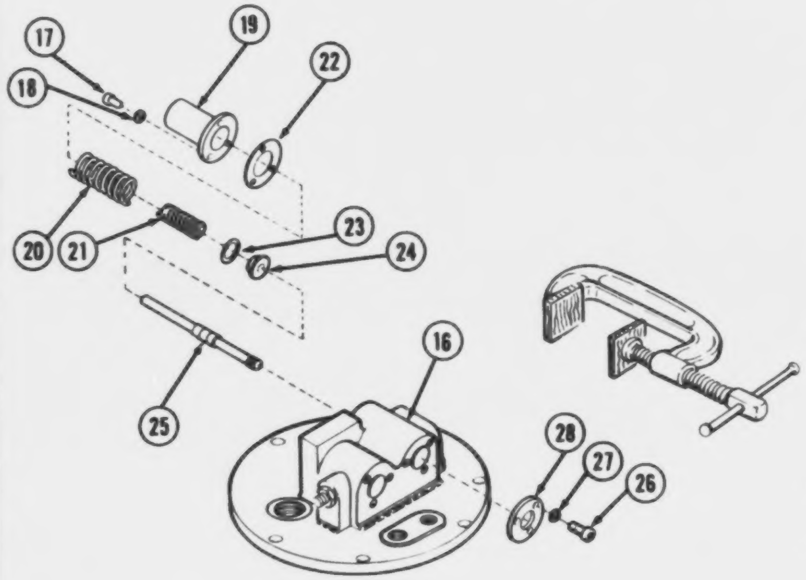
9 Remove power valve spool (9).

10 Remove and discard gasket (10).

11 Remove three screws (11), three lock washers (12) and cover (13). Discard three lock washers (12).

12 Remove and discard gasket (14).

13 Remove spring (15) from power valve section (5). Discard spring (15).



14 Place two wood blocks and "C"-clamp over ends of pressure regulator section (16) to restrain spring-loaded parts during disassembly.

15 Remove three socket head cap screws (17) and three lock washers (18). Discard three lock washers (18).

WARNING

Remove housing with care, as it contains a spring-loaded spool within the body.

16 Unscrew "C"-clamp slowly, allowing internal springs to expand. Support housing (19) throughout this step. Remove "C"-clamp and two wood blocks when all spring preload is released.

17 Remove housing (19).

18 Remove and discard large spring (20), inner spring (21), gasket (22), flat washer (23) and spring seat (24).

19 Remove pressure regulator spool (25).

20 Remove three socket head cap screws (26), three lock washers (27) and cover (28). Discard three lock washers (27).

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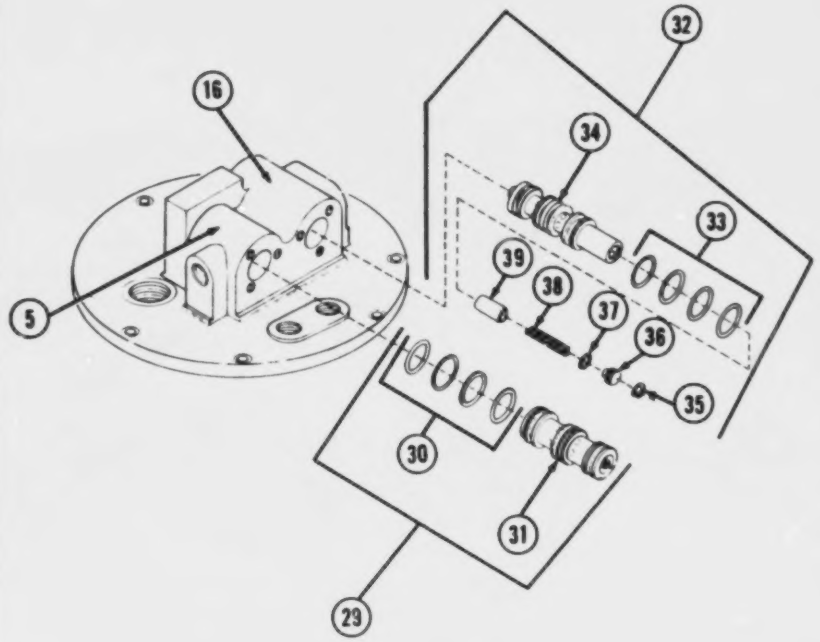
CAB HYDRAULICS — Continued

5-2. COVER ASSEMBLY – Continued

a. Disassembly-Continued



21 Remove power valve sleeve group (29) from power valve section (5). Be careful not to damage finished surfaces of spool and housing.

22 Remove and discard four preformed packings (30) from power valve spool sleeve (31).

23 Remove pressure regulator sleeve group (32) from pressure regulator section (16).

24 Remove and discard four preformed packings (33) from pressure regulator spool sleeve (34).

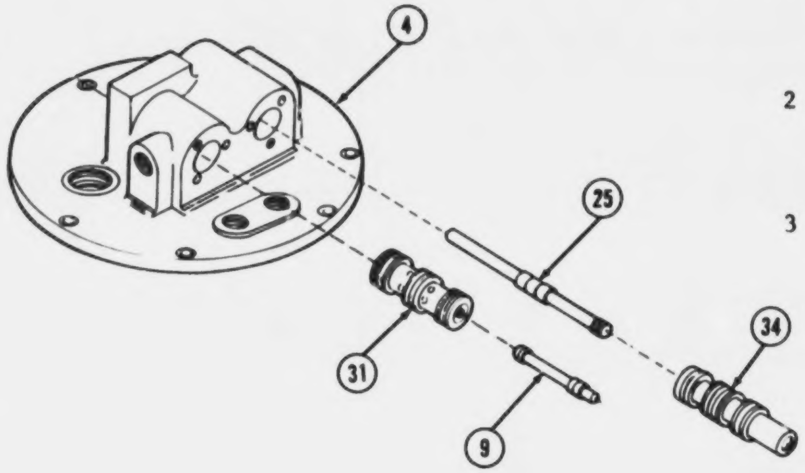
25 Remove retaining ring (35) while restraining spring retainer (36).

26 Remove spring retainer (36) from pressure regulator spool sleeve (34).

27 Remove and discard preformed packing (37).

28 Remove spool compression spring (38) and spring snubber (39).

b. Inspection



1 Inspect pressure regulator spool (25) and pressure regulator spool sleeve (34). Replace as a matched set if either piece is scratched or burred.

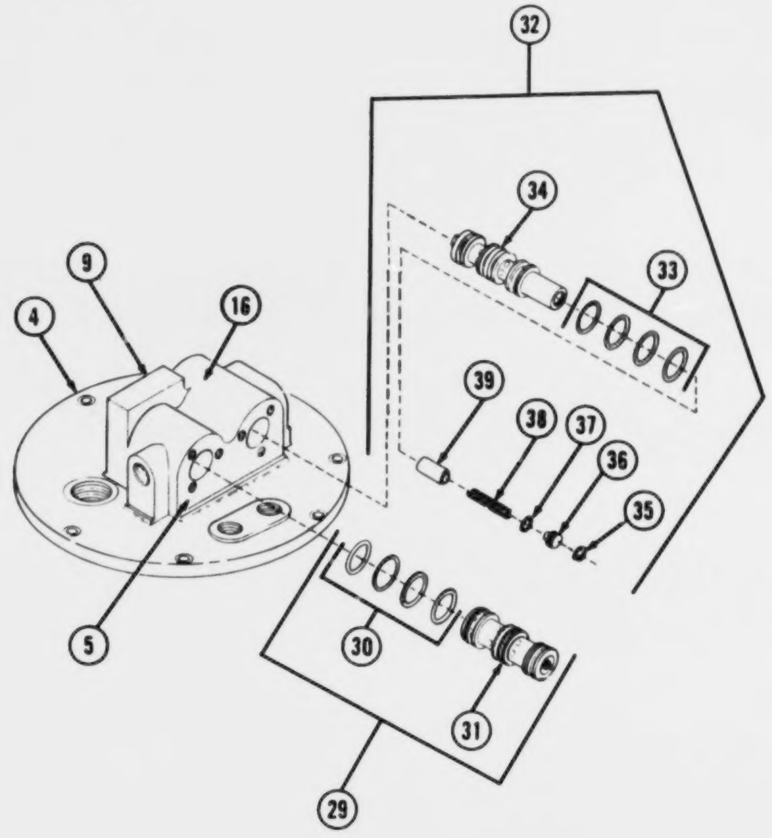
2 Inspect power valve spool (9) and power valve spool sleeve (31). Replace as a matched set if either piece is scratched or burred.

3 Inspect cover (4). Replace if cracked, distorted or damaged.

CAB HYDRAULICS — Continued

5-2. COVER ASSEMBLY — Continued

c. Assembly



1 Install spring snubber (39) and spool compression spring (38).

2 Install new preformed packing (37).

3 Install spring retainer (36) on pressure regulator spool sleeve (34).

4 Compress spring retainer (36) and install retaining ring (35).

5 Install four new preformed packings (33) on pressure regulator spool sleeve (34).

6 Insert pressure regulator sleeve group (32) into pressure regulator section (16) of cover (4).

7 Install four new preformed packings (30) on power valve spool sleeve (31).

8 Being careful not to damage finished surfaces of power valve spool (9) and housing (19), insert power valve sleeve group (29) into power valve section (5) of cover (4).

9 Install cover (28), three new lock washers (27) and three socket head cap screws (26).

10 Install pressure regulator spool (25).

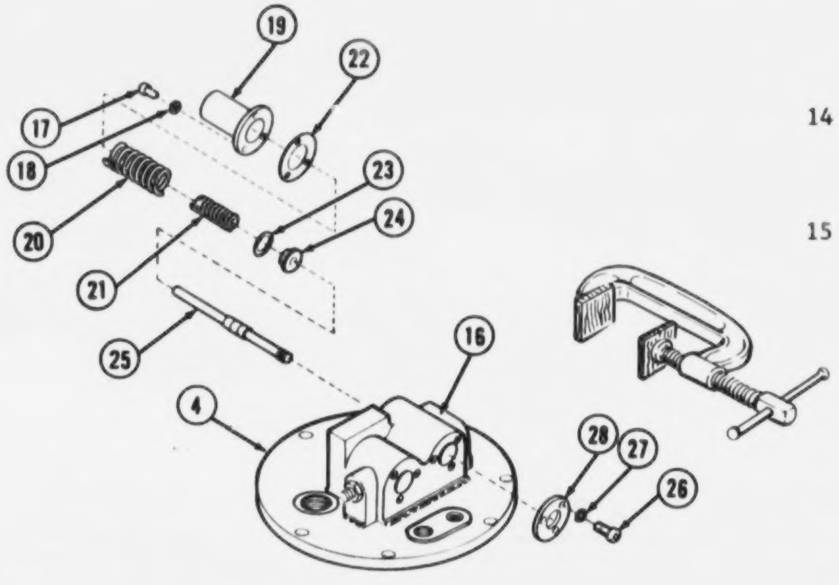
11 Install new spring seat (24), new flat washer (23), new inner spring (21), new large spring (20) and new gasket (22).

12 Place housing (19) over pressure regulator parts and support housing (19).

13 Using two wood blocks to protect parts, install "C"-clamp over pressure regulator section (16) and slowly tighten to compress inner spring (21) and large spring (20) under housing (19).

14 Secure housing (19) to cover (4) with three new lock washers (18) and three socket head cap screws (17).

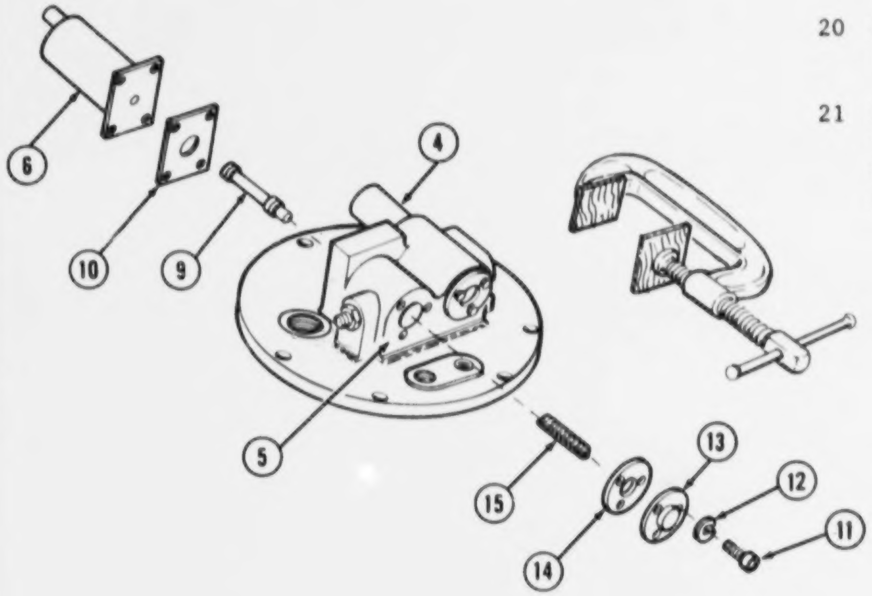
15 Remove "C"-clamp and two wood blocks.



CAB HYDRAULICS — Continued

5-2. COVER ASSEMBLY – Continued

c. Assembly-Continued



16 Install new spring (15) in power valve section (5) of cover (4).

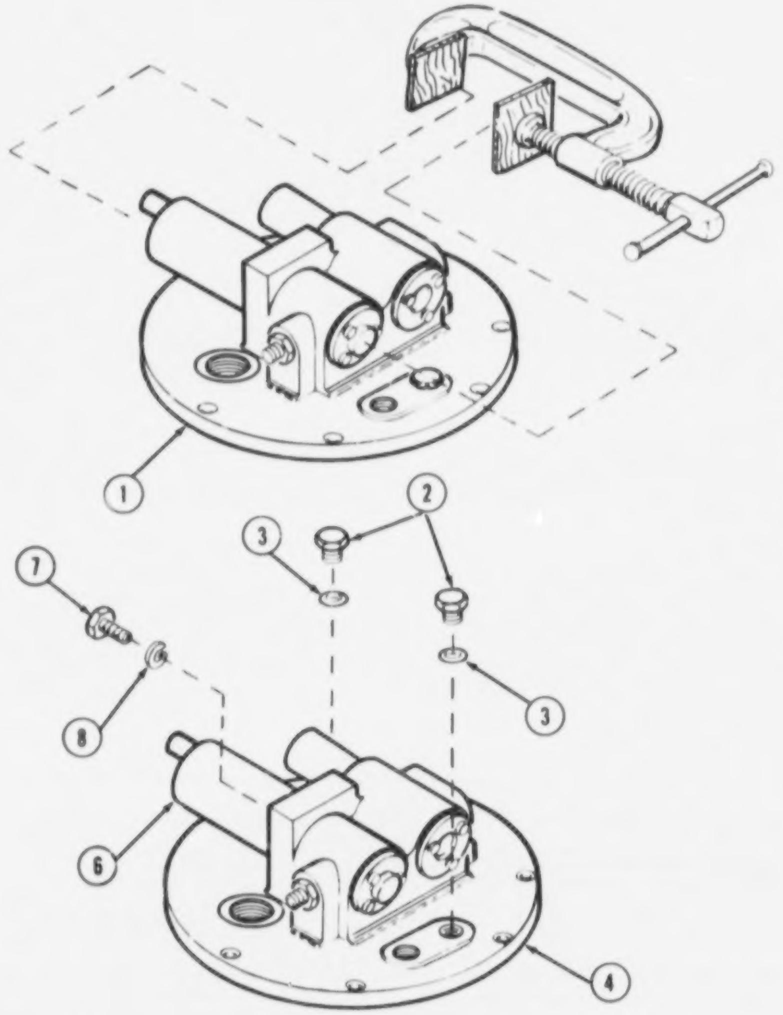
17 Install new gasket (14).

18 Install cover (13). Secure with three new lock washers (12) and three screws (11).

19 Install power valve spool (9) and new gasket (10).

20 Position solenoid (6) over power valve spool (9) and support solenoid (6).

21 Place two wood blocks over end of solenoid (6) and cover (13). Install "C"-clamp over two wood blocks and tighten "C"-clamp slowly until spring (15) is fully compressed.



22 Secure solenoid (6) to cover (4) with four new lock washers (8) and four socket head cap screws (7).

23 Remove "C"-clamp and two wood blocks.

24 Install two new preformed packings (3) and two plugs (2) in cover (4).

25 Install cover assembly (1) (ref. page 5-10).

CAB HYDRAULICS — Continued

5-3. FILTER ASSEMBLY (M109A2/M109A3)

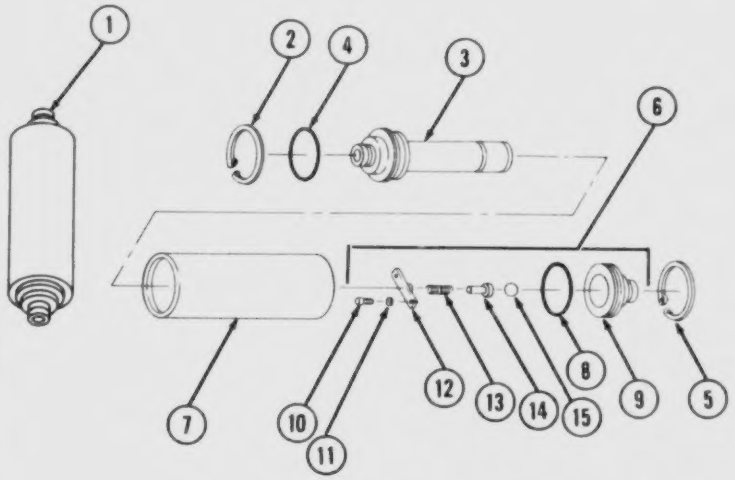
This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts
Hydraulic fluid (Item 10, App. C)
Preformed packings
Filter element

Personnel Required
2

a. Disassembly



1 Remove filter assembly (1) (ref. page 5-5).

2 Remove retaining ring (2) at top end of filter assembly (1).

3 Remove filter (3).

4 Remove and discard preformed packing (4) from filter (3).

5 Remove retaining ring (5) at pump end of filter (3).

6 Remove head and ball check valve group (6) from body (7).

7 Remove and discard preformed packing (8) from head (9).

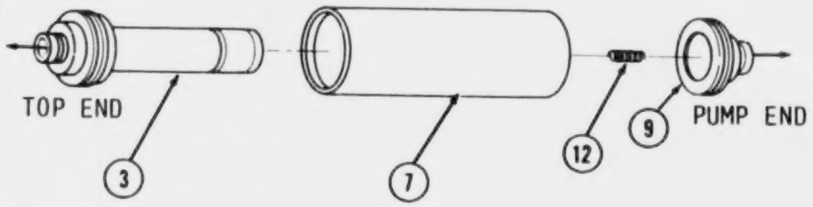
8 Remove two screws (10, two lock washers (11) and retainer (12) from head (9). Discard two lock washers (11).

9 Remove spring (13), guide (14) and ball bearing (15) from head (9).

CAB HYDRAULICS — Continued

5-3. FILTER ASSEMBLY (M109A2/M109A3)—Continued

b. Inspection



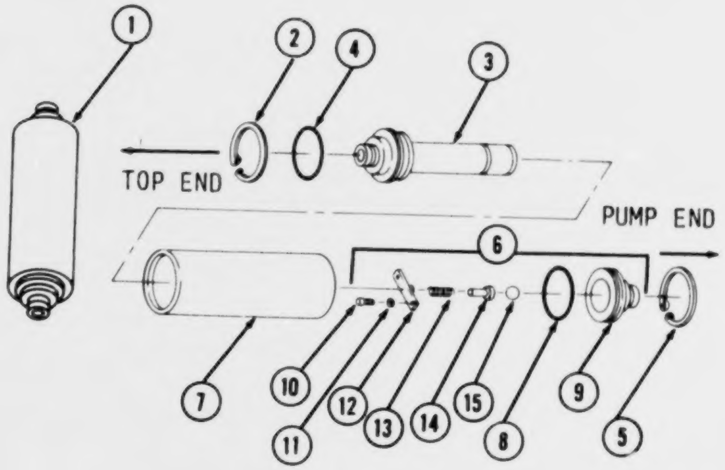
1 Replace filter (3) only with part number 12257235.

2 Inspect body (7) and replace if distorted or cracked.

3 Inspect spring (12) and replace if distorted, cracked, scratched or damaged.

4 Inspect head (9) and replace if cracked, distorted or damaged.

c. Assembly



NOTE

Be sure to use only five micron filter, part number 12257235.

1 Install ball bearing (15), guide (14) and spring (13) in head (9).

2 Secure retainer (12) to head (9) with two new lock washers (11) and two screws (10).

3 Coat new preformed packing (8) with clean hydraulic fluid (Item 10, App. C) and install on head (9).

4 Insert head and ball check valve group (6) into body (7).

5 Install retaining ring (5) at pump end of filter (3).

6 Coat new preformed packing (4) with clean hydraulic fluid (Item 10, App. C) and install on filter (3).

7 Install filter (3) in body (7)

8 Install retaining ring (2) at top end of filter assembly (1).

9 Install filter assembly (1) (ref. page 5-10).

CAB HYDRAULICS—Continued

5-3.1. BODY ASSEMBLY (M109A4)

This task covers: a. Disassembly b. Inspection c. Assembly

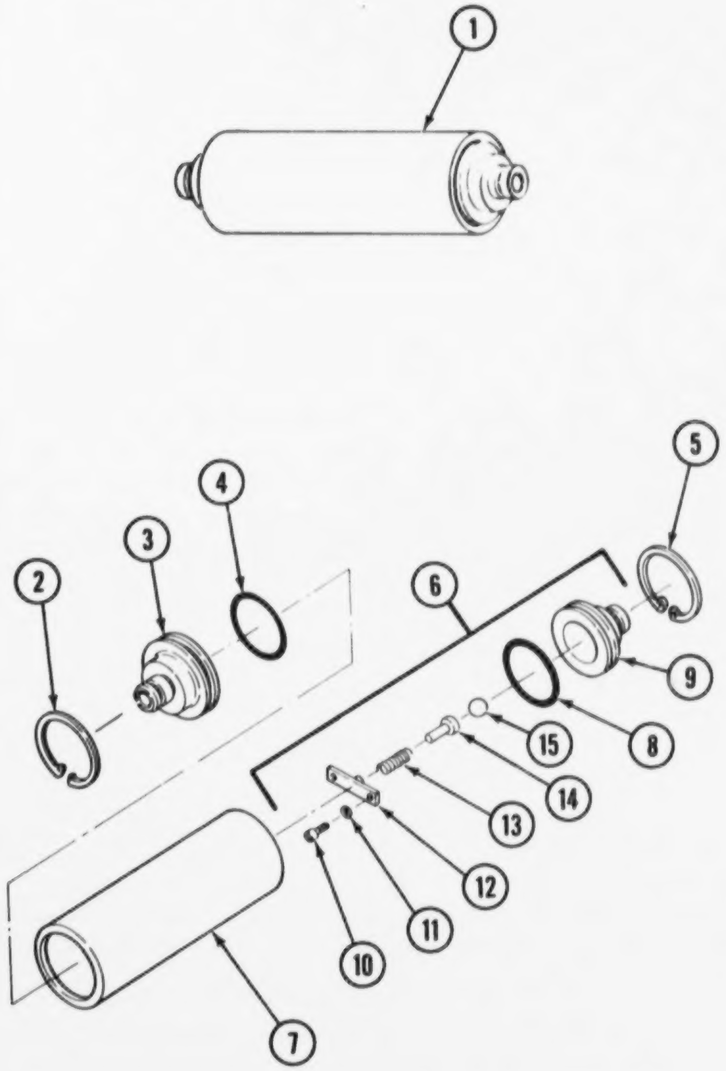
INITIAL SET-UP

Materials/Parts
Hydraulic fluid (Item 10, App. C)
Preformed packings
Lockwashers

Personnel Required
2

References
Body assembly removal p 5-5
TM 9-2350-311-20-2

a. **Disassembly**



1 Remove body assembly (1) (ref. page 5-5).

2 Remove retaining ring (2), cap (3), and preformed packing (4) at top end of body assembly (1). Discard preformed packing.

3 Remove retaining ring (5) at pump end of body assembly (1).

4 Remove head and ball check valve group (6) from body (7).

5 Remove and discard preformed packing (8) from head (9).

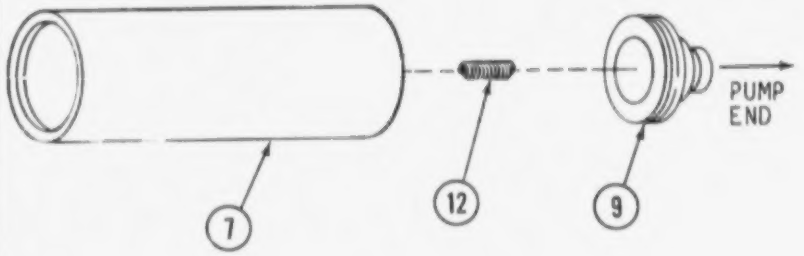
6 Remove two screws (10), two lock washers (11), and retainer (12) from head (9). Discard two lock washers (11).

7 Remove spring (13), guide (14), and ball bearing (15) from head (9).

CAB HYDRAULICS—Continued

5-3.1. BODY ASSEMBLY (M109A4)—Continued

b. Inspection

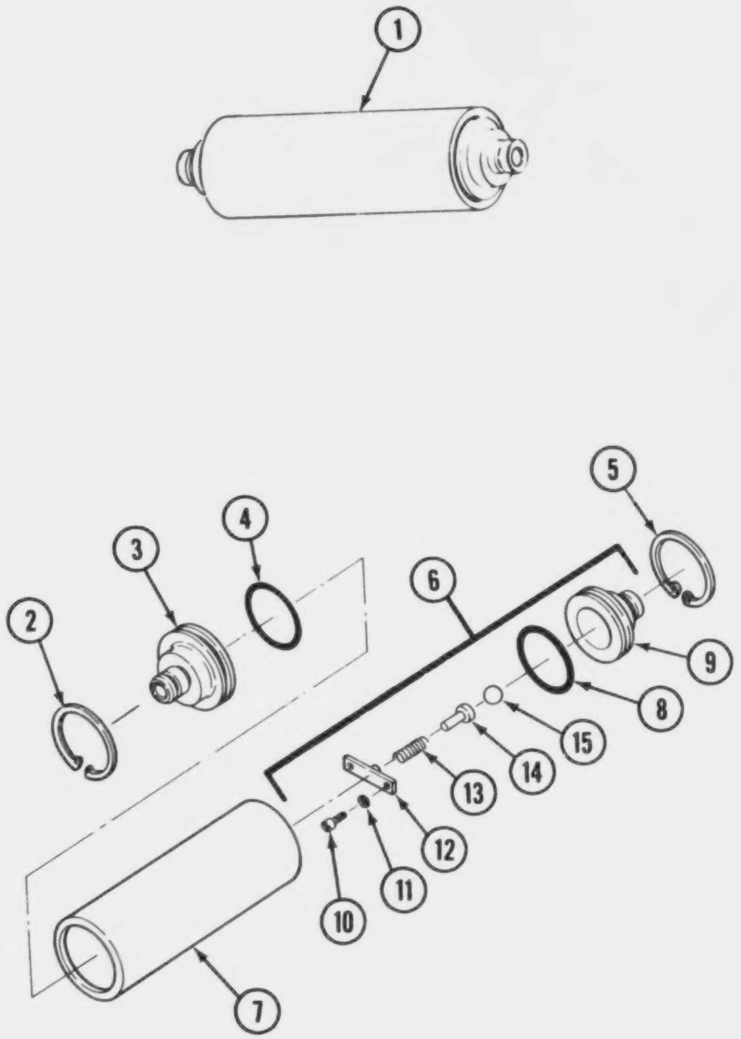


1 Inspect body (7) and replace if distorted or cracked.

2 Inspect spring (12) and replace if distorted, cracked, scratched or damaged.

3 Inspect head (9) and replace if cracked, distorted or damaged.

c. Assembly



1 Install ball bearing (15), guide (14), and spring (13) in head (9).

2 Secure retainer (12) to head (9) with two new lock washers (11) and two screws (10).

3 Coat new preformed packing (8) with clean hydraulic fluid (Item 10, App. C) and install on head (9).

4 Insert head and ball check valve group (6) into body (7).

5 Install retaining ring (5) at pump end of body assembly (1).

6 Coat new preformed packing (4) with clean hydraulic fluid (Item 10, App. C) and install on cap (3).

7 Install cap (3) and retaining ring (2) at top end of body assembly (1).

8 Install body assembly (1) (ref. page 5-10).

CAB HYDRAULICS — Continued

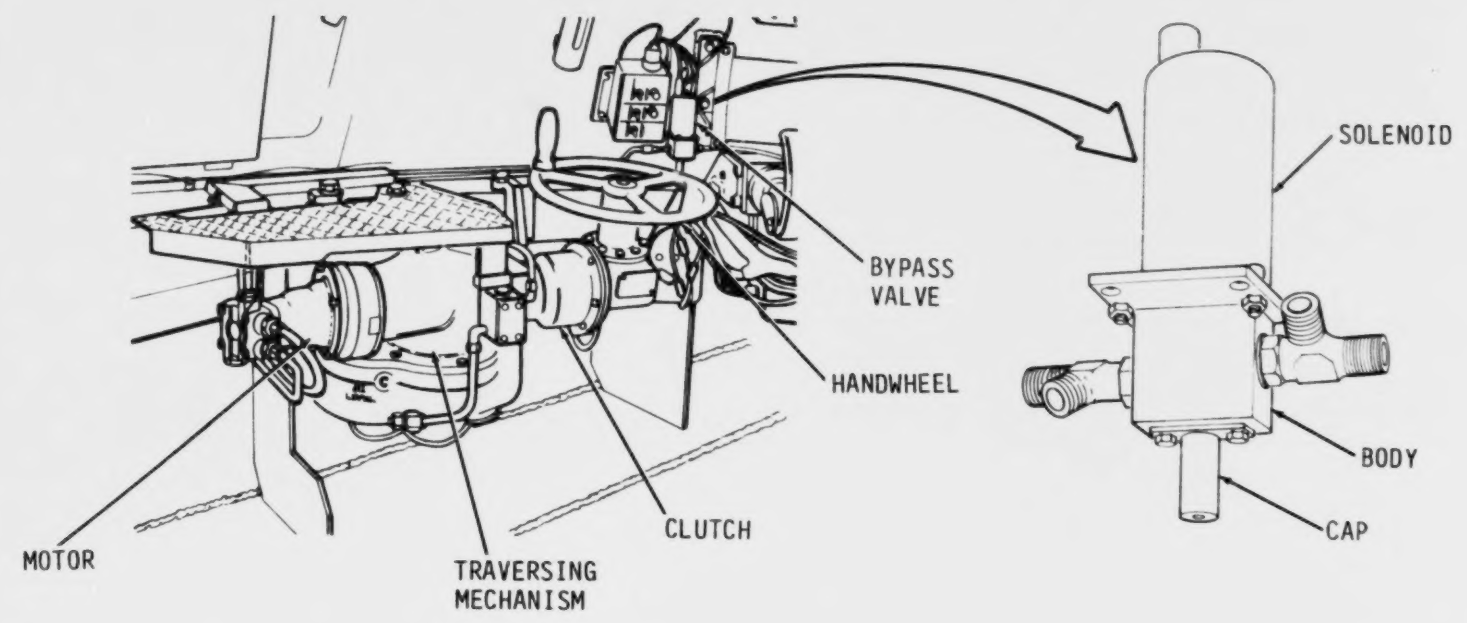
5-4. BYPASS VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

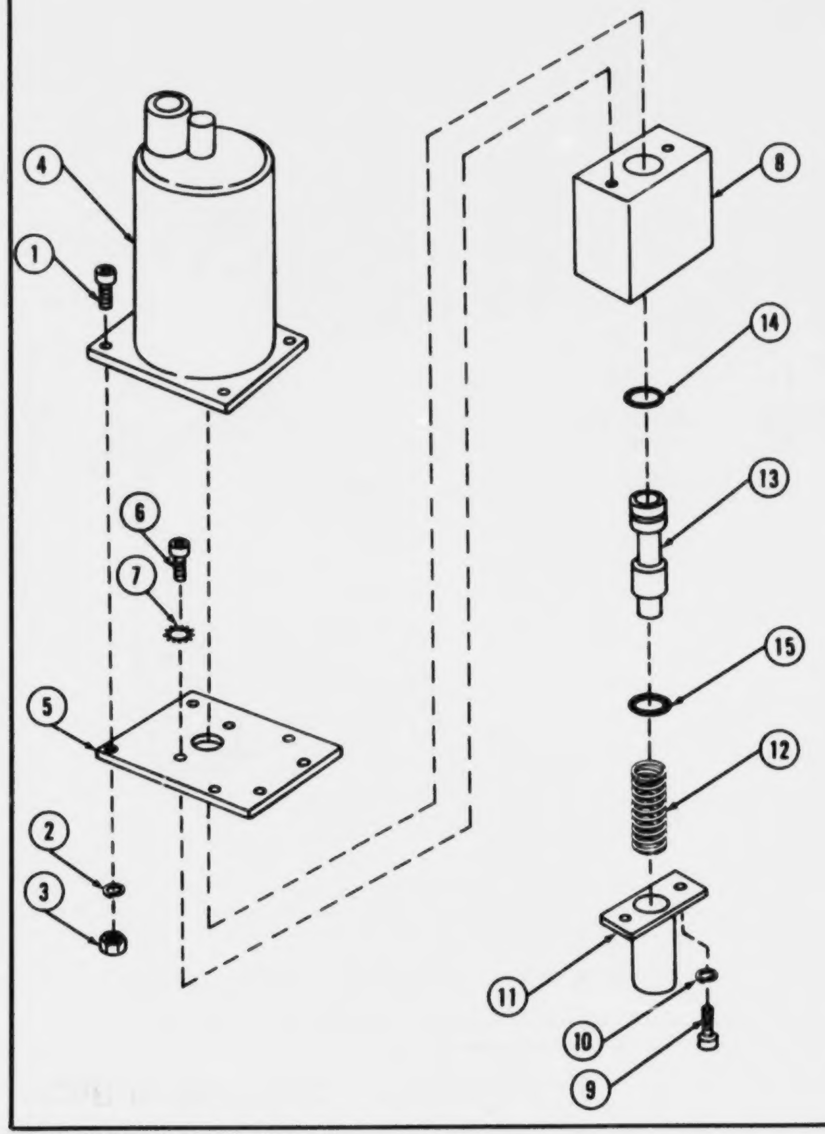
INITIAL SET-UP

Materials/Parts

Preformed packings
Lock washers


SOLENOID
BYPASS VALVE
HANDWHEEL
BODY
CAP
CLUTCH
MOTOR
TRAVERSING MECHANISM

a. Disassembly



1 For removal of bypass valve assembly (ref. TM 9-2350-311-20-2).

2 Remove four socket head cap screws (1), four lock washers (2) and four nuts (3). Discard four lock washers (2).

3 Separate solenoid (4) from spacer (5).

4 Remove two socket head cap screws (6), two lock washers (7) and spacer (5) from body (8). Discard two lock washers (7).

5 Remove two socket head cap screws (9), two lock washwers (10), cap (11) and spring (12) from body (8). Discard two lock washers (10).

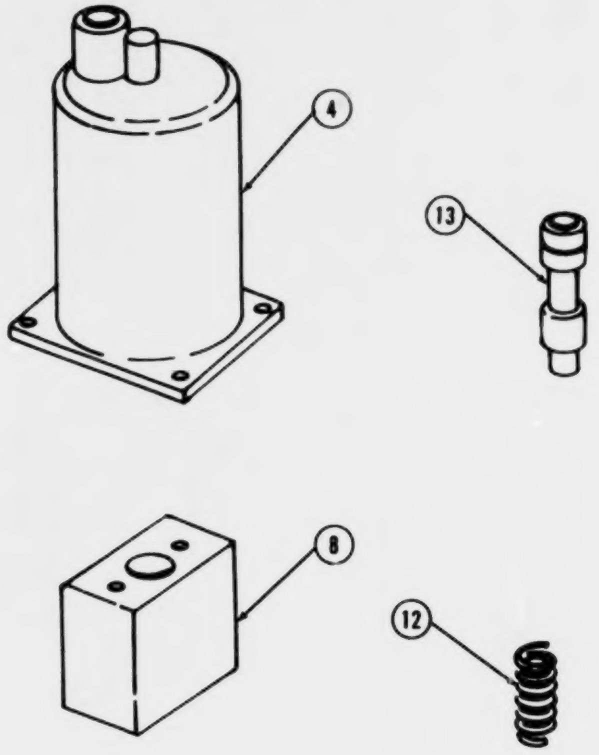
6 Remove spool (13) from body (8).

7 Remove and discard preformed packings (14 and 15) from spool (13).

CAB HYDRAULICS — Continued

5-4. BYPASS VALVE ASSEMBLY — Continued

b. Inspection



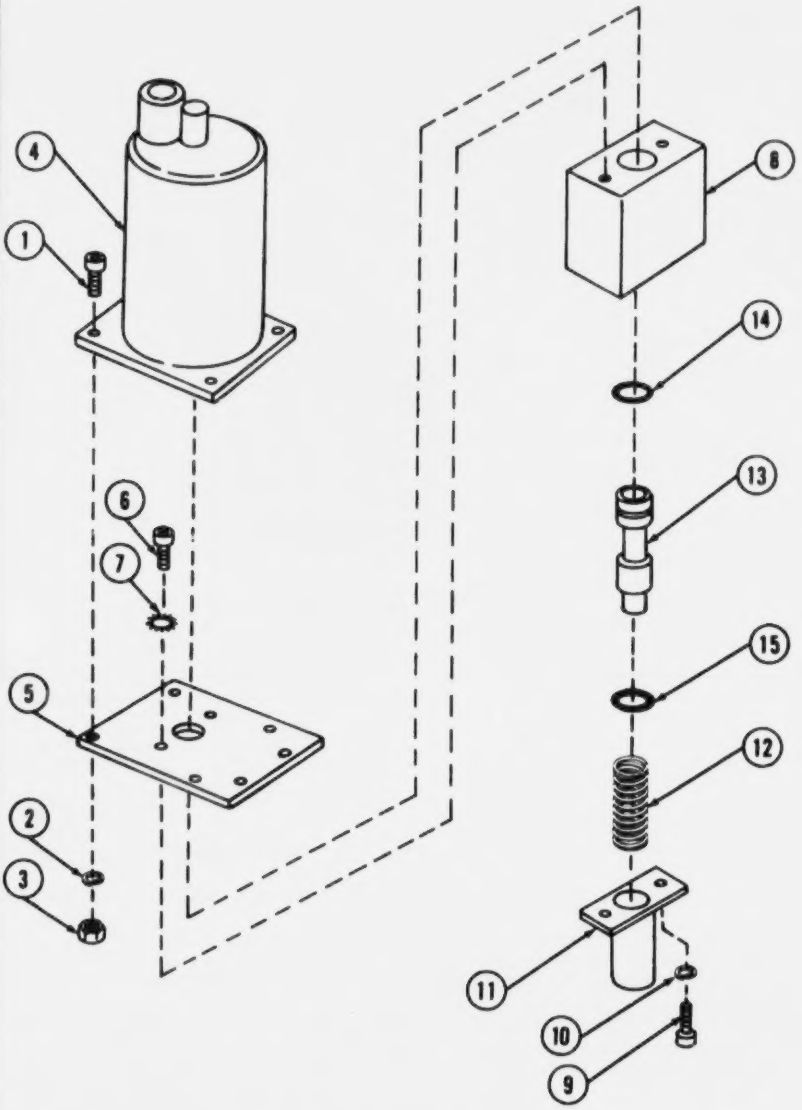
1 Test solenoid (4) for continuity. Replace if defective.

2 Inspect body (8). Replace as a matched set with spool (13) if cracked, distorted or scratched in bore.

3 Inspect spool (13). Replace as a matched set with body (8) if cracked, distorted or scored.

4 Inspect spring (12). Replace if cracked, broken, distorted or scratched.

c. Assembly



1 Install new preformed packings (14 and 15) on spool (13).

2 Insert spool (13) into body (8).

3 Install spring (12), cap (11), two new lock washers (10) and two socket head cap screws (9) to body (8).

4 Install spacer (5) on body (8) and secure with two new lock washers (7) and two socket head cap screws (6).

5 Place solenoid (4) on spacer (5) and secure with four nuts (3), four new lock washers (2) and four socket head cap screws (11).

6 Install bypass valve assembly (ref. TM 9-2350-311-20-2).

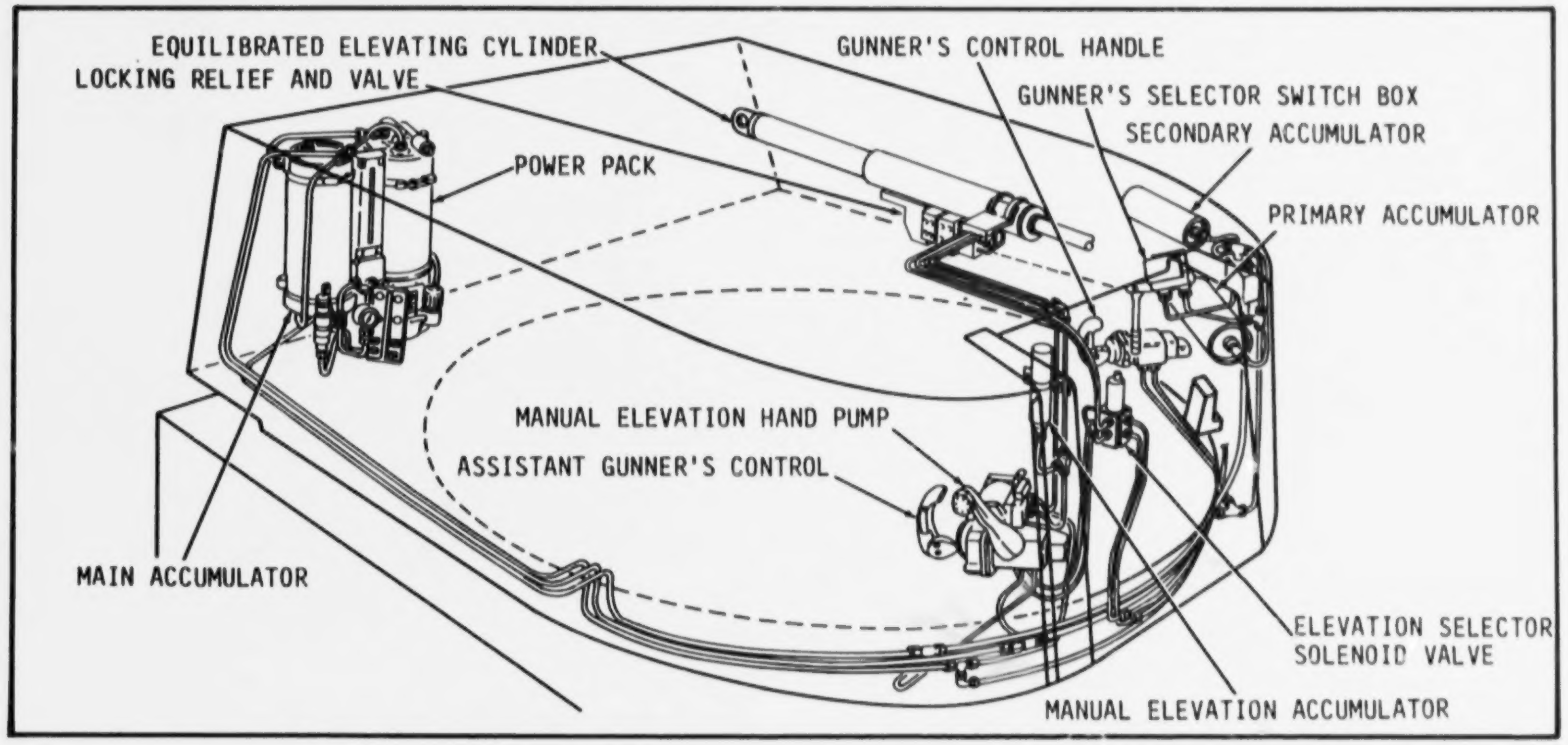
CAB HYDRAULICS — Continued

5-5. LINES AND FITTINGS FROM PRIMARY AND SECONDARY ACCUMULATORS TO EQUILIBRATED ELEVATING CYLINDER

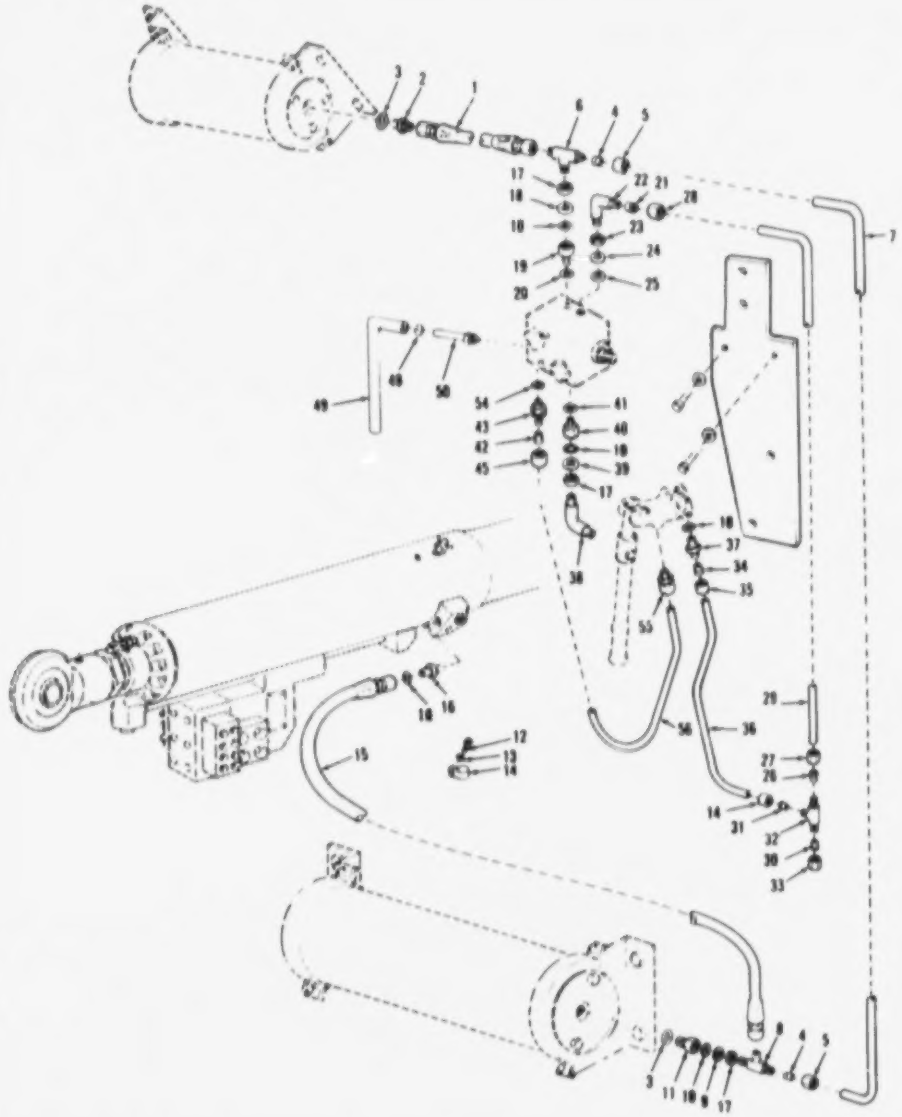
This task covers: Removal and Installation

INITIAL SET-UP

Materials/Parts
Preformed packings


EQUILIBRATED ELEVATING CYLINDER
LOCKING RELIEF AND VALVE
GUNNER'S CONTROL HANDLE
GUNNER'S SELECTOR SWITCH BOX
SECONDARY ACCUMULATOR
POWER PACK
PRIMARY ACCUMULATOR
MANUAL ELEVATION HAND PUMP
ASSISTANT GUNNER'S CONTROL
MAIN ACCUMULATOR
ELEVATION SELECTOR SOLENOID VALVE
MANUAL ELEVATION ACCUMULATOR

Removal and Installation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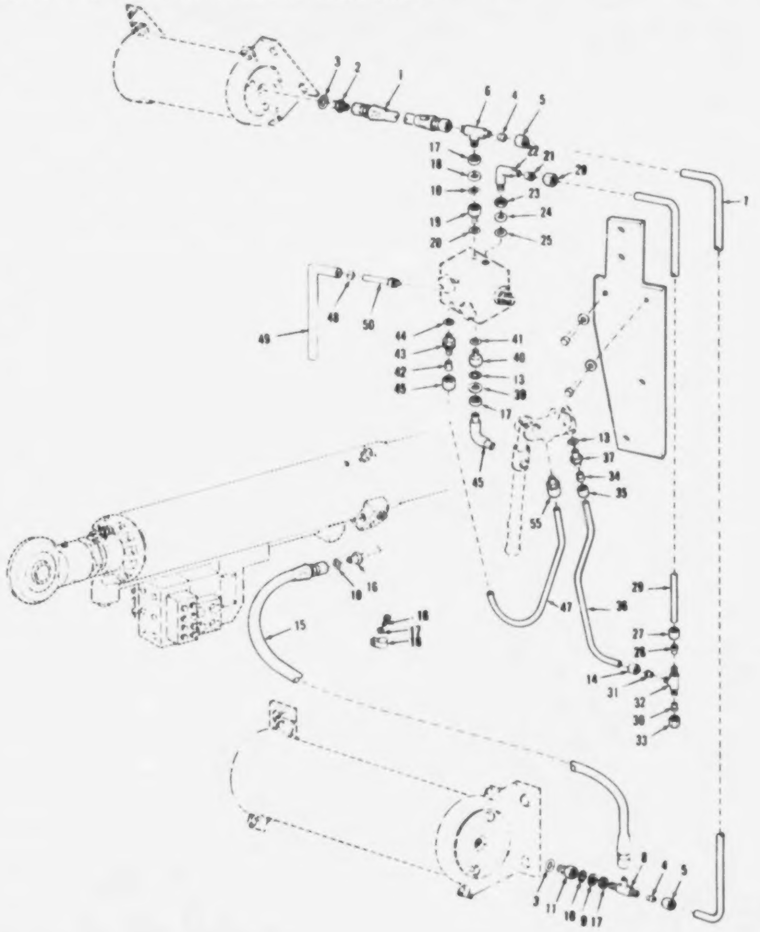
Follow illustration as a guide.

1. Hose assembly
2. Tube reducer
3. Preformed packing (2)
4. Clinch sleeve (2)
5. Tube coupling nut (2)
6. Tube tee
7. Tube
8. Tube tee
9. Flat washer
10. Preformed packing (5)
11. Machine thread bushing
12. Hexhead cap screw (3)
13. Lock washer (3)
14. Loop clamp (3)
15. Hose assembly
16. Nipple
17. Tube fitting locknut (3)
18. Flat washer
19. Straight adapter
20. Preformed packing
21. Clinch sleeve
22. Elbow

CAB HYDRAULICS — Continued

5-5. LINES AND FITTINGS FROM PRIMARY AND SECONDARY ACCUMULATORS TO EQUILIBRATED ELEVATING CYLINDER – Continued

Removal and Installation-Continued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Follow illustration as a guide.

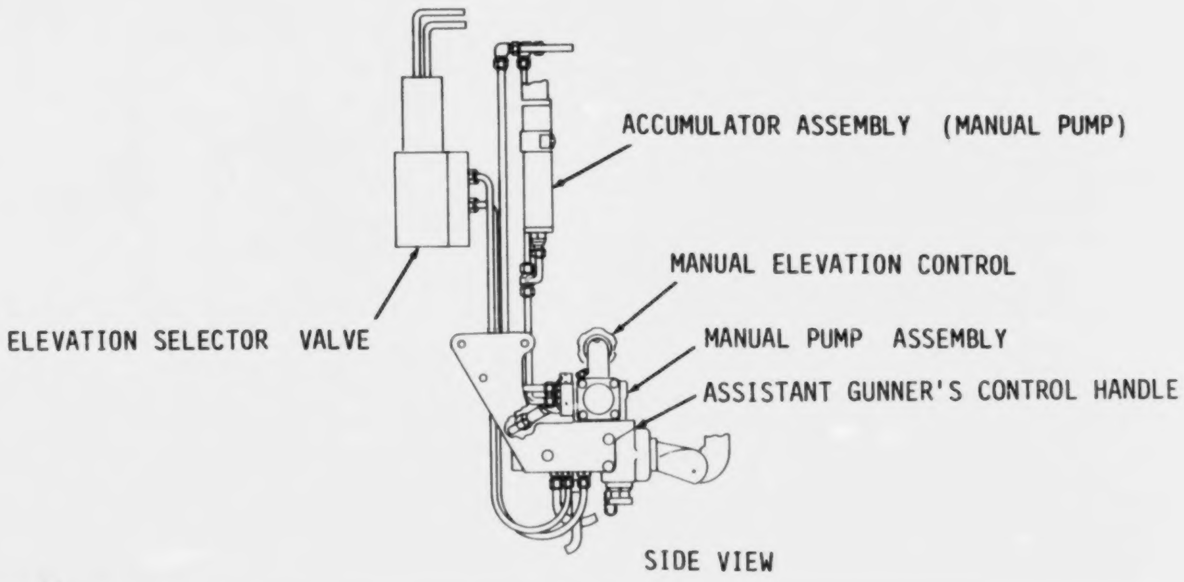
23. Tube fitting locknut
24. Flat washer
25. Preformed packing
26. Clinch sleeve
27. Tube coupling nut
28. Tube coupling nut
29. Bent metallic tube
30. Clinch sleeve
31. Clinch sleeve
32. Tube tee
33. Tube coupling nut
34. Clinch sleeve
35. Tube coupling nut
36. Bent metallic tube
37. Tube reducer
38. Elbow
39. Flat washer
40. Straight adapter
41. Preformed packing
42. Clinch sleeve
43. Tube reducer
44. Preformed packing
45. Tube coupling nut
46. Straight adapter
47. Bent metallic tube
48. Hose clamp
49. Non-metallic hose
50. Straight adapter

5-6. ACCUMULATOR ASSEMBLY (MANUAL PUMP)

This task covers: a. Removal b. Disassembly c. Inspection
d. Assembly e. Service f. Test g. Installation

INITIAL SET-UP

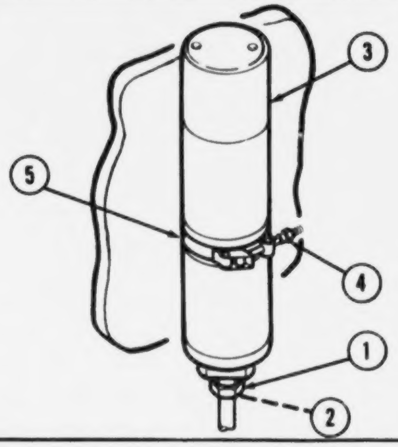
Materials/Parts	Special Tools	Personnel Required
Dry nitrogen (Item 18, App. C) Hydraulic fluid (Item 10, App. C) Preformed packings Suitable container Packing retainers	Accumulator charging regulator (Item 10, App. B) Micrometers, inside and outside	2


ACCUMULATOR ASSEMBLY (MANUAL PUMP)
MANUAL ELEVATION CONTROL
ELEVATION SELECTOR VALVE
MANUAL PUMP ASSEMBLY
ASSISTANT GUNNER'S CONTROL HANDLE
SIDE VIEW

CAB HYDRAULICS — Continued

5-6. ACCUMULATOR ASSEMBLY (MANUAL PUMP) – Continued

a. Removal

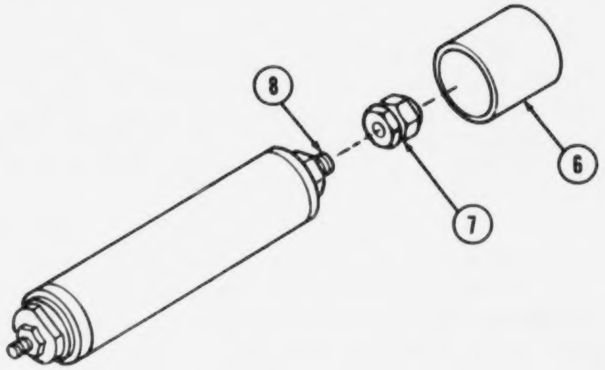


1 To relieve hydraulic system pressure (ref. TM 9-2350-311-20-2).

2 Loosen hexnut (1) and clinch sleeve (2) and disconnect hydraulic line at base of accumulator (3). Catch hydraulic fluid which will drain from accumulator (3) in a suitable container.

3 Loosen nut (4), open clamp (5) and lift out accumulator (3).

b. Disassembly



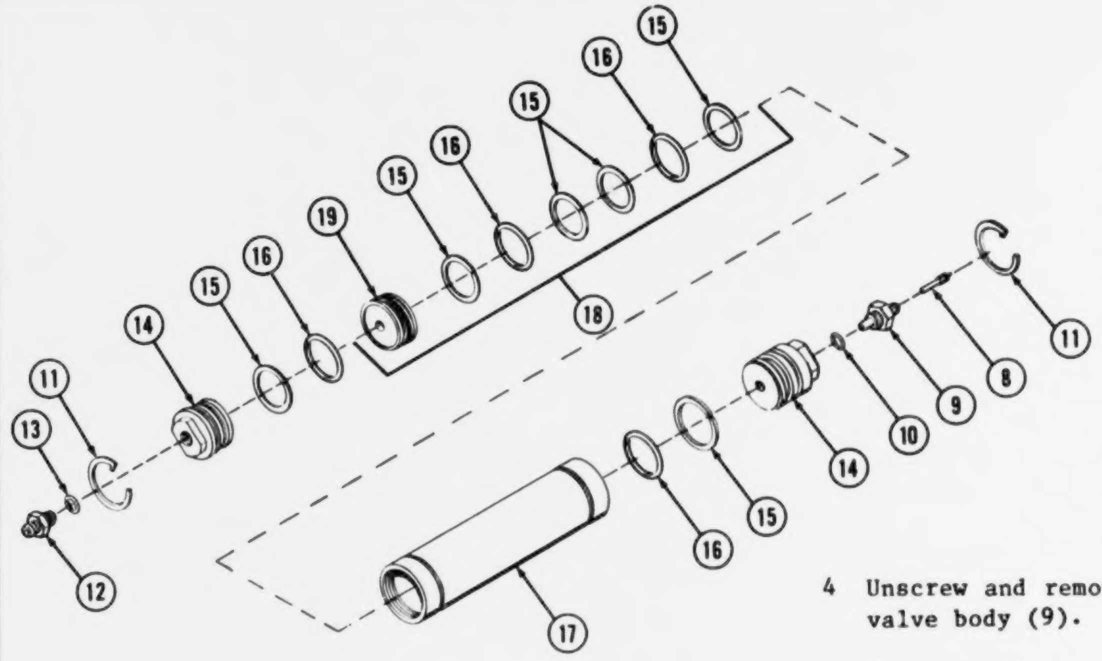
WARNING

Accumulator contains dry nitrogen at a pressure of 75-90 psi (517-620 kPa). Do not disassemble until all pressure is relieved.

1 Remove end cap (6).

2 Unscrew and remove pneumatic valve cap (7).

3 Depress valve core (8) and relieve all nitrogen pressure in accumulator (3).



4 Unscrew and remove valve core (8) from air valve body (9).

5 Unscrew and remove air valve body (9).

6 Remove and discard preformed packing (10).

7 Remove two retaining rings (11) from outside of cylinder (17) at each end.

8 Remove nipple adapter (12).

9 Remove and discard preformed packing (13).

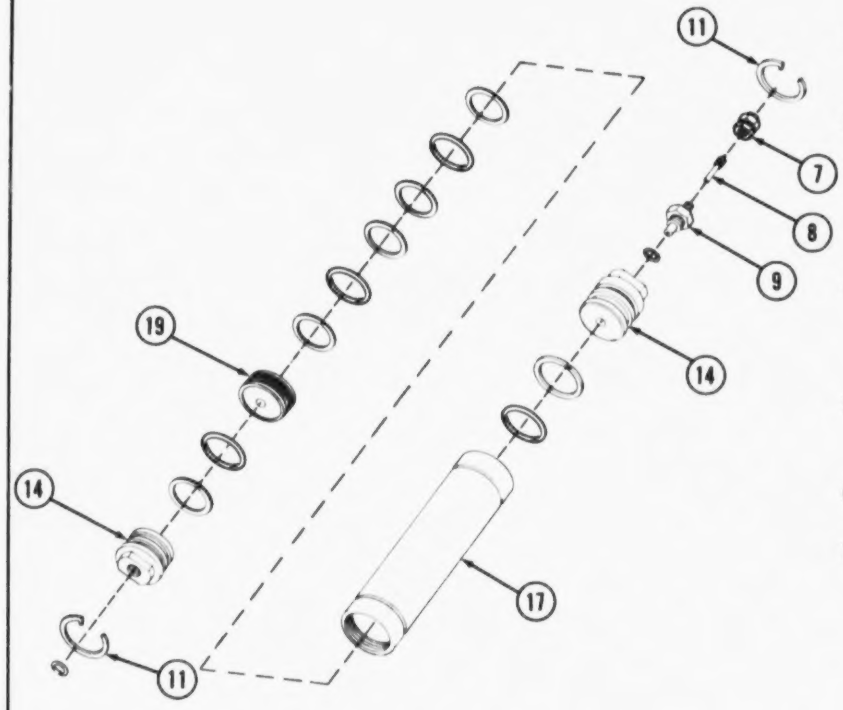
10 Remove two fittings (14) and piston assembly (18) from cylinder (17).

11 Remove and discard six packing ring retainers (15) and four preformed packings (16) from piston (19).

CAB HYDRAULICS — Continued

5-6. ACCUMULATOR ASSEMBLY (MANUAL PUMP) – Continued

c. Inspection



1 Inspect two fittings (14). Replace if fractured.

2 Inspect two retaining rings (11). Replace if unserviceable.

3 Inspect cylinder (17). Replace complete accumulator assembly if cylinder (17) is cracked or scored inside, threads are damaged or if inside diameter is greater than 1.518 inches (38.5 mm).

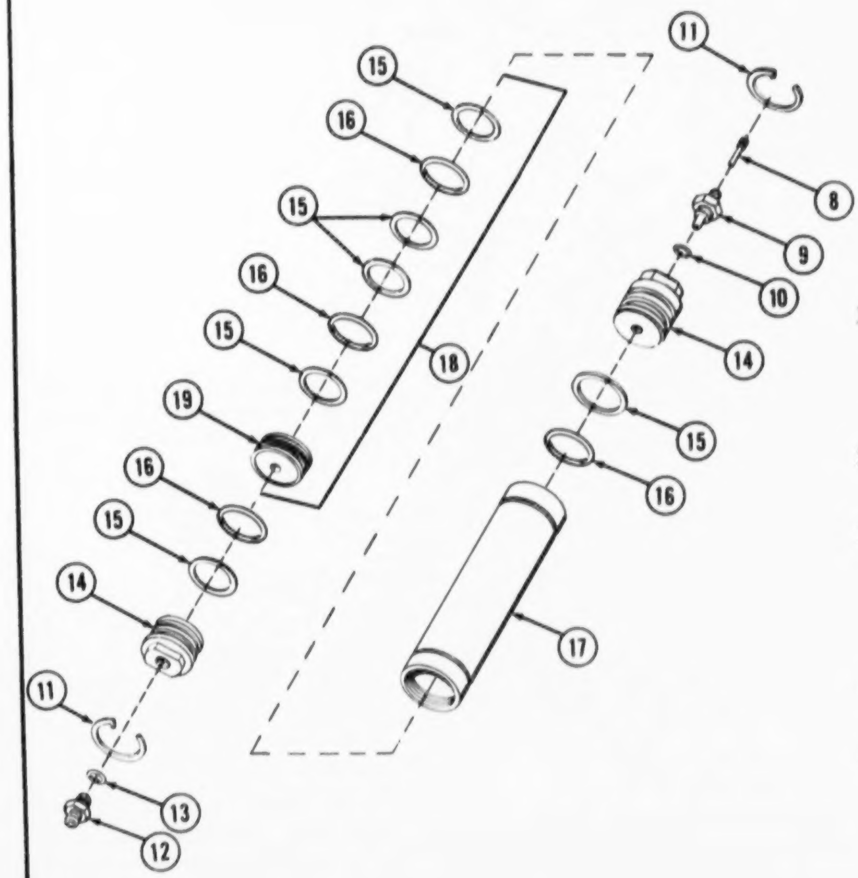
4 Inspect piston (19). Replace if cracked, grooves are burred or outside diameter is less than 1.5 inches (38.2 mm).

5 Inspect air valve body (9). Replace if threads are damaged.

6 Replace valve core (8) if it leaks.

7 Inspect pneumatic valve cap (7). Replace if cracked.

d. Assembly



CAUTION

Do not distort preformed packings when installing. Be careful not to damage machined surfaces of piston, inside surface of cylinder, or threads at each end of cylinder. Avoid damage when inserting piston into cylinder.

1 Coat four new preformed packings (16) with hydraulic fluid (Item 10, App. C). Install four new preformed packings (16) and six new packing ring retainers (15) on piston (19).

2 **Install piston assembly (18) and two fittings (14) in cylinder (17).**

3 Coat new preformed packing (13) with hydraulic fluid (Item 10, App. C). Install new preformed packing (13) and nipple adapter (12).

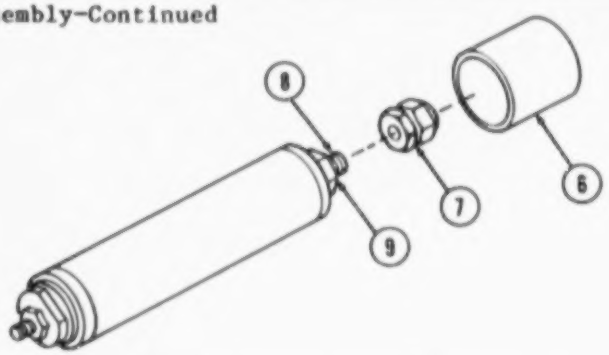
4 **Install two retaining rings (11), one at each end of cylinder (17).**

5 Coat new preformed packing (10) with hydraulic fluid (Item 10, App. C). Install new preformed packing (10) and air valve body (9) on fitting (14).

CAB HYDRAULICS — Continued

5-6. ACCUMULATOR ASSEMBLY (MANUAL PUMP) — Continued

d. Assembly-Continued

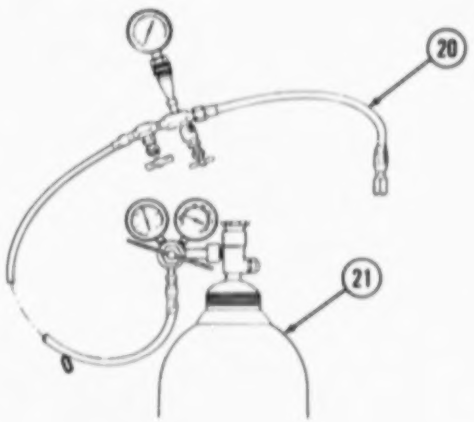


6 Screw valve core (8) into air valve body (9).

7 Charge accumulator with dry nitrogen.

8 Install pneumatic valve cap (7) and end cap (6).

e. **Service** - Method One



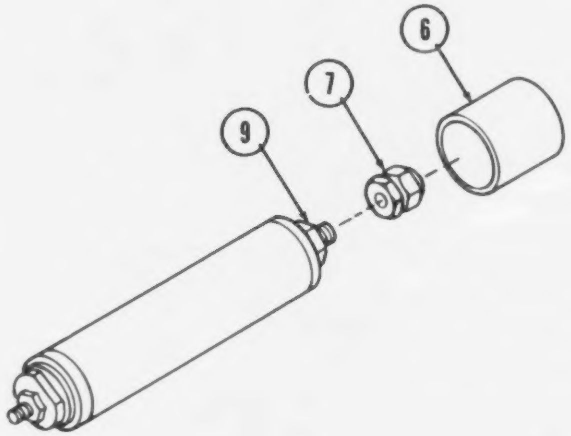
1 If accumulator is installed in vehicle, relieve pressure in hydraulic system (ref. TM 9-2350-311-20-2).

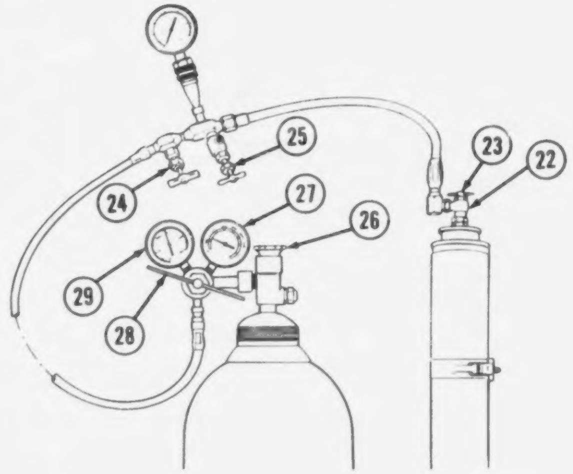
2 Disconnect the two lower hydraulic tubes at the elevating mechanism locking valve. Catch the hydraulic fluid in a suitable container.

WARNING

Make sure charging cylinder contains dry nitrogen. Dry nitrogen tanks are marked with one or two black bands. Certain other gases can cause accumulator to explode, resulting in possible injury.

3 Obtain accumulator charging regulator (20) (Item 10, App. B). Attach to nitrogen cylinder (21) as shown and tighten.





4 Remove end cap (6) and pneumatic valve cap (7).

5 Attach valve (22) to air valve body (9), but do not tighten. Back out stem (23) of valve (22) until stem no longer contacts air valve core.

6 Close valves (24 and 25) of charging device.

7 Open nitrogen cylinder shutoff valve (26) and observe nitrogen cylinder pressure gage (27). Pressure must be greater than 90 psi (620 kPa).

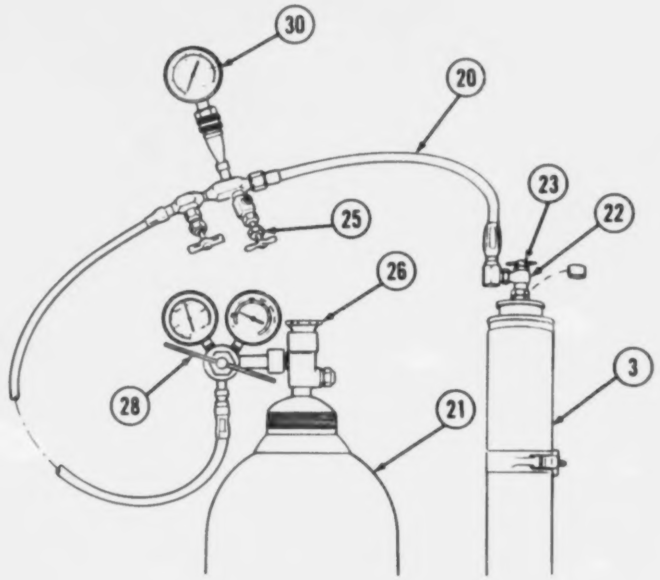
8 Open pressure regulator valve (28) until gage (29) reaches 15-20 psi (103-137 kPa), then close pressure regulator valve (28).

9 Open valve (24) and tighten valve (22) just before gage (29) reaches zero.

CAB HYDRAULICS — Continued

5-6. ACCUMULATOR ASSEMBLY (MANUAL PUMP) – Continued

e. Service - Method one - Continued



10 Open pressure regulator valve (28) until gage (30) reaches 75-90 psi (517-620 kPa).

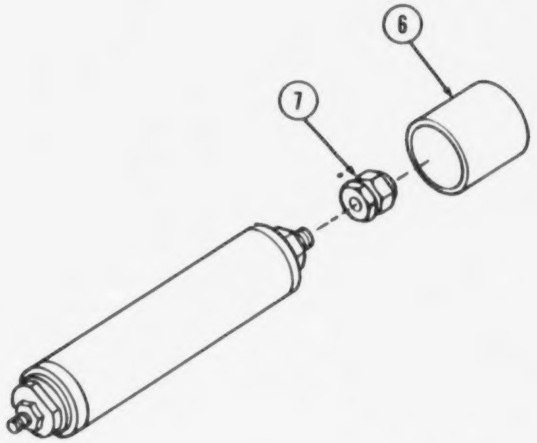
11 Turn in stem (23) of valve (22) (clockwise) until nitrogen begins to enter accumulator (3). Allow accumulator (3) to fill slowly.

12 Close pressure regulator valve (28) when sound of nitrogen flowing into accumulator (3) has stopped.

13 Back out stem (23) of valve (22) all the way (counterclockwise).

14 Open valve (25) slowly to release pressure in the charging device.

15 Remove valve (22) from accumulator (3).



16 Install pneumatic valve cap (7) and end cap (6).

17 Close nitrogen cylinder shutoff valve (26) by turning clockwise.

18 Remove charging regulator (20) from nitrogen cylinder (21).

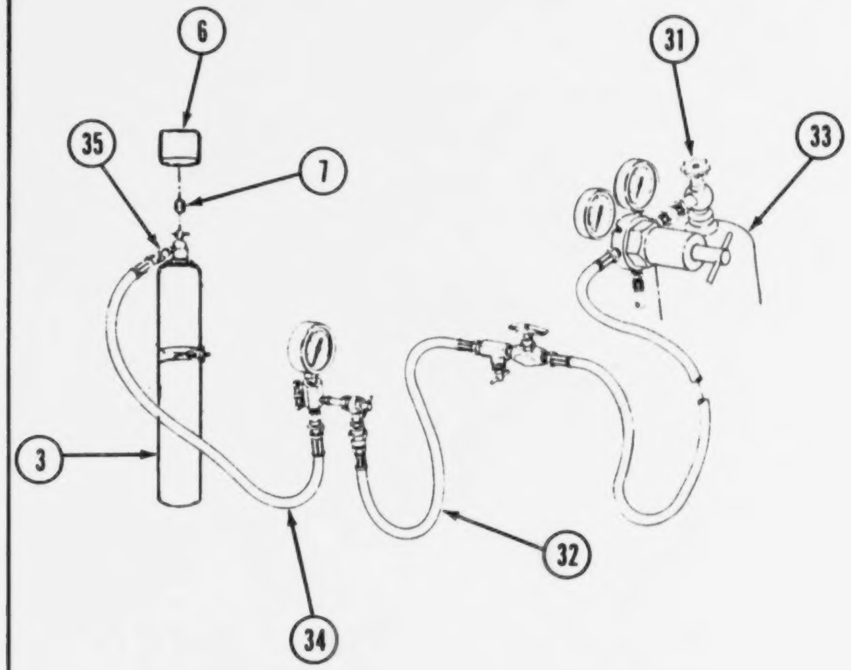
19 Connect elevating cylinder hydraulic lines to locking valve and tighten nuts if accumulator is mounted in vehicle.

20 Refill, charge and bleed hydraulic system (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY - MANUAL PUMP – Continued

f. Service (Method Two)



1 Remove cab access cover if accumluator is installed in cab (ref. TM 9-2350-311-20-2).

2 Discharge pressure in hydraulic system (ref. TM 9-2350-311-20-2).

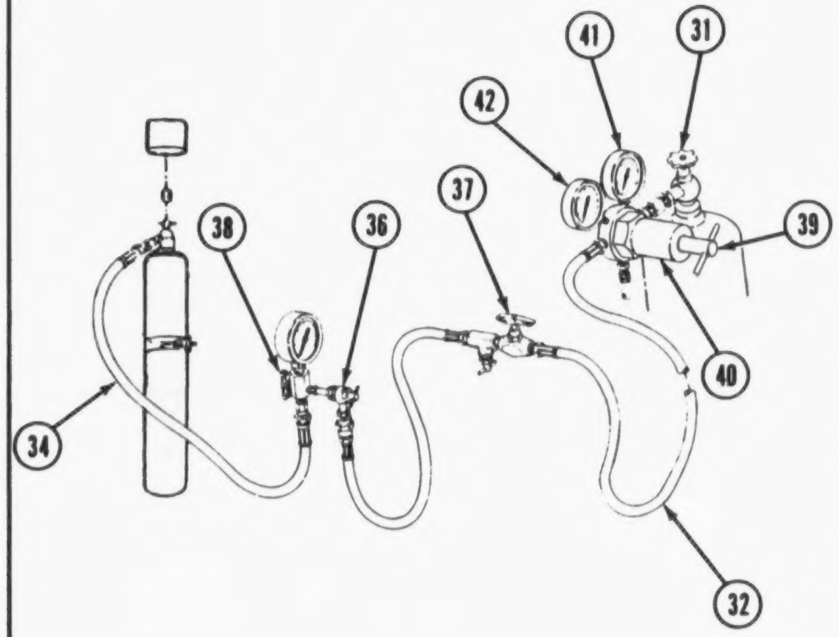
WARNING

Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

3 Open and close shutoff valve (31) to clear valve seat of any dust or dirt. Repeat this operation after installation of presure regulator to clear hose.

4 Connect and tighten nitrogen charging device (32) to nitrogen charging cylinder (33) as shown.

5 Remove end cap (6), remove valve cap (7). Connect nitrogen checking device (34) to valve body (35) on accumulator (3).



6 Connect nitrogen charging device (32) to nitrogen checking device (34).

7 Open valve (36).

8 Close valve (37).

9 Close bleeder valve (38).

10 Open check valve (39) by turning clockwise.

11 Close pressure regulator valve (40) by turning counterclockwise until no spring pressure is felt.

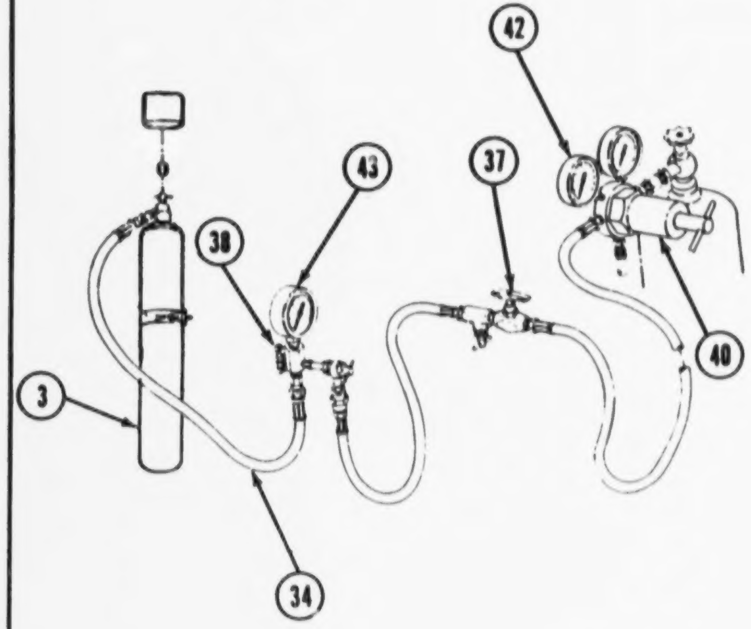
12 Open shutoff valve (31) slowly until full cylinder pressure is indicated on 4000 psi gage (41) of pressure indicator.

13 Open pressure regulator valve (40) slowly, turning it clockwise until pressure on 3000 psi gage (42) registers 50 psi (345 kPa).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMLY - MANUAL PUMP - Continued

f. Service (Method Two)-Continued



14 Open valve (37), allowing nitrogen to enter the accumulator (3) until gage (43) on the nitrogen checking device (34) reads 50 psi (345 kPa).

15 Close valve (37).

16 Open bleeder valve (38) until all nitrogen is bled from accumulator (3), then close bleeder valve (38).

17 Repeat steps 12 and 13 to remove all traces of moisture prior to charging system to full pressure. Reopen valve (37).

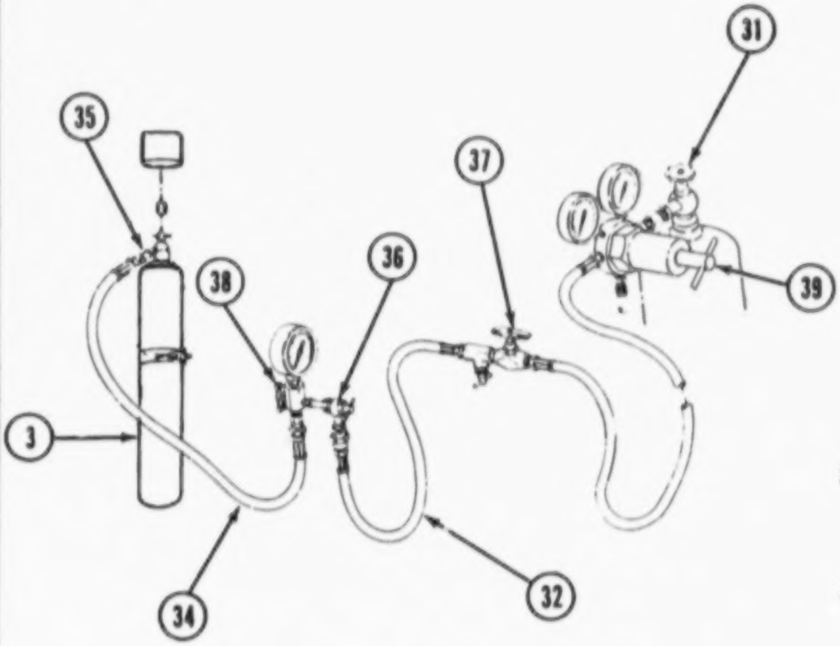
CAUTION

Charging the system too fast will heat the dry nitrogen. This will give an inaccurate reading because the pressure will decrease when the nitrogen cools.

NOTE

Estimated time to charge system is 30 minutes or more. System should be charged at ambient temperature of weapon use.

18 Open pressure regulator valve (40) slowly, turning clockwise until pressure on 3000 psi gage (42) registers 110 psi (730 kPa) at 70°F (21°C).



19 Open valve (37) slowly, allowing nitrogen to charge system.

WARNING

- Failure to close check valve on main accumulator and pressure regulator valve could result in injury from high pressure in hoses of nitrogen charging device and nitrogen checking device.
- Failure to open bleeder valve could result in injury from high pressure trapped in hoses of nitrogen charging device and nitrogen checking device.

20 Close check valve (39) and shutoff valve (31). Let system remain idle for one hour after charging.

21 Open bleeder valve (38) to bleed pressure from nitrogen charging device (32) and nitrogen checking device (34).

22 Disconnect nitrogen charging device (32) and nitrogen checking device (34) at valve (36).

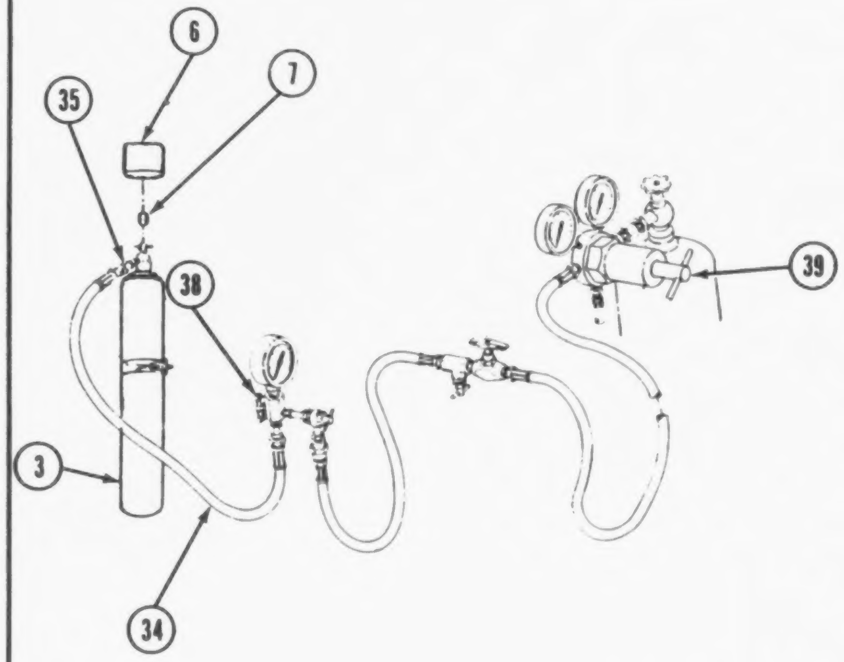
23 Close pressure regulator valve (40) by turning counterclockwise.

24 Disconnect nitrogen charging device (32) from shutoff valve (31).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY - MANUAL PUMP — Continued

f. Service (Method Two)-Continued



25 Close bleeder valve (38).

26 Open check valve (39).

27 Slowly open bleeder valve (38), reducing pressure to 90 psi (650 kPa) on accumulator (3), then close bleeder valve (38).

28 Close check valve (39).

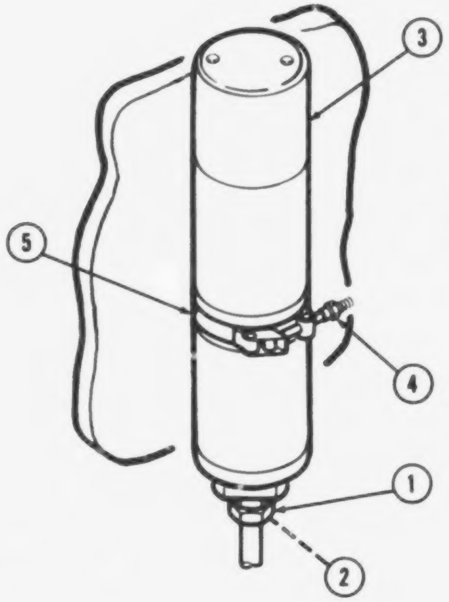
29 Open bleeder valve (38).

30 Disconnect nitrogen checking device (34) from valve body (35) on accumulator (3).

31 Replace valve cap (7).

32 Replace end cap (6).

g. Installation



1 Insert accumulator (3) into clamp (5) and secure with nut (4).

2 Connect hydraulic line to base of accumulator (3). Tighten hexnut (1) over clinch sleeve (2) to secure line.

3 Refill and bleed hydraulic system (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN)

This task covers:
- a. Removal
- b. Disassembly
- c. Inspection
- d. Assembly
- e. Service (Method One)
- f. Service (Method Two)
- g. Test
- h. Installation

INITIAL SET-UP

Materials/Parts
- Dry nitrogen (Item 18, App. C)
- Packing retainer
- Suitable container, 1 to 5 gallon capacity
- Repair parts kit P/N 10923100
- Hydraulic fluid (Item 10, App. C)
- Preformed packings
- Ring guides

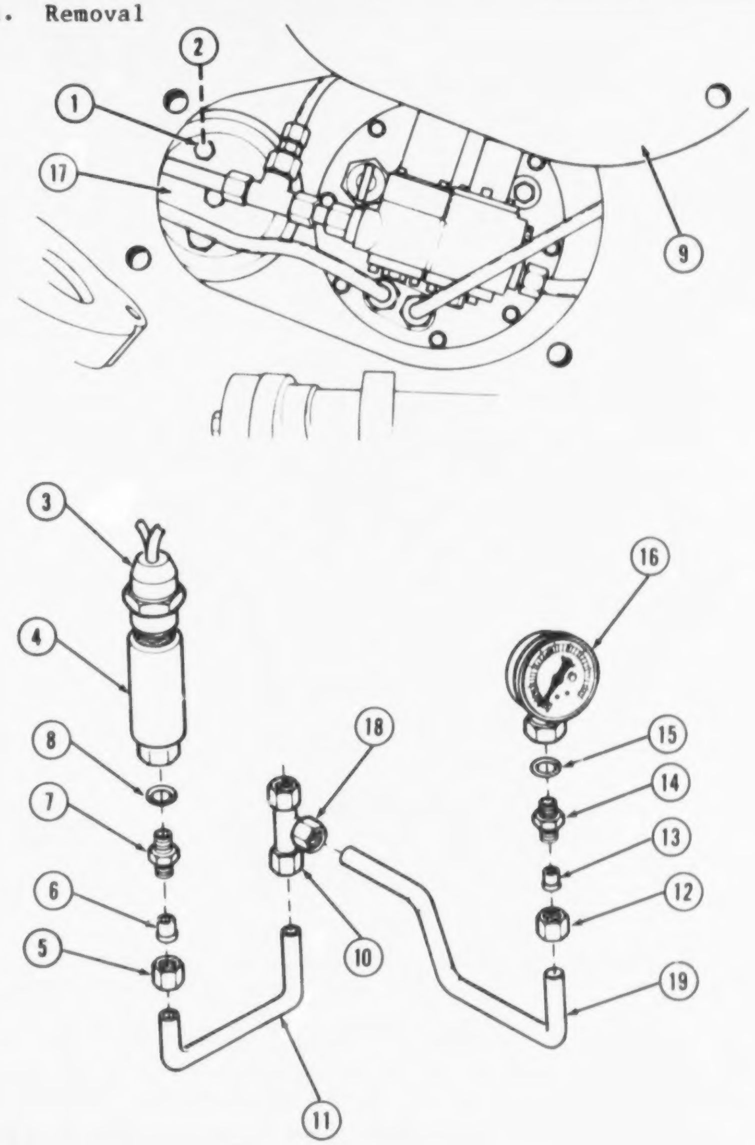
Special Tools
- Extension valve, charging accumulator (Item 9, App B)
- Accumulator charging regulator (Item 10, App. B)
- Nitrogen charging kit (Item 11, App. B)

Personnel Required
2

WARNING

Wear safety glasses and steel tipped safety shoes to avoid possible injury while handling equipment.

a. Removal



1 Discharge pressure and drain cab hydraulic system (ref. TM 9-2350-311-20-2).

2 Remove cab access cover (9) (ref. TM 9-2350-311-20-2).

3 Loosen hex nut (1).

4 Screw lock screw (2) at top of accumulator (17) upward until it is completely unscrewed from top of accumulator (17).

5 Disconnect female plug (3) (circuit No. 645) at pressure switch (4).

6 Remove tube coupling nut (5), clinch sleeve (6), straight adapter (7), preformed packing (8) and pressure switch (4). Discard preformed packing (8).

7 Loosen nut (10) on tube tee.

8 Remove tube (11).

9 Remove tube coupling nut (12), clinch sleeve (13), adapter (14), preformed packing (15) and pressure gage (16). Discard preformed packing (15).

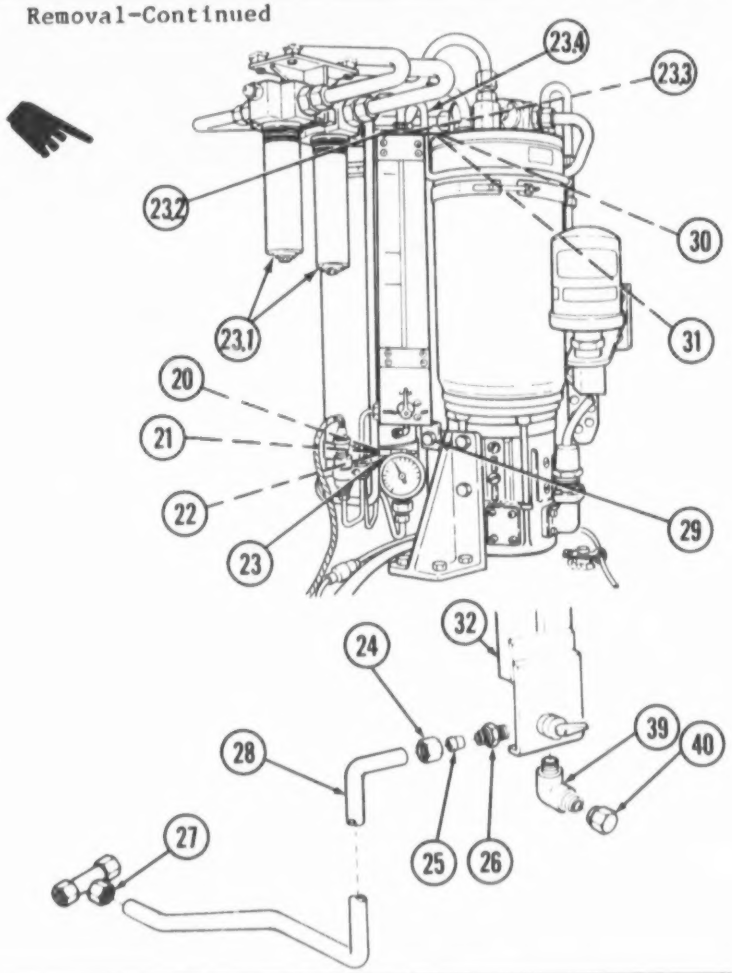
10 Loosen nut (18) on tube tee.

11 Remove tube (19).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) — Continued

a. Removal-Continued



12 Remove screw (20), nut (21), lock washer (22) and clamp (23). Discard lock washer (22).

NOTE

Steps 12.1 and 12.2 apply to M109A4 howitzers only.

12.1 Remove hydraulic filter assemblies (23.1) (ref. TM 9-2350-311-20-2).

12.2 Remove clamp (23.2), hose (23.3), and tube (23.4) from top of liquid indicator gage.

13 Remove tube coupling nut (24), clinch sleeve (25) and adapter (26).

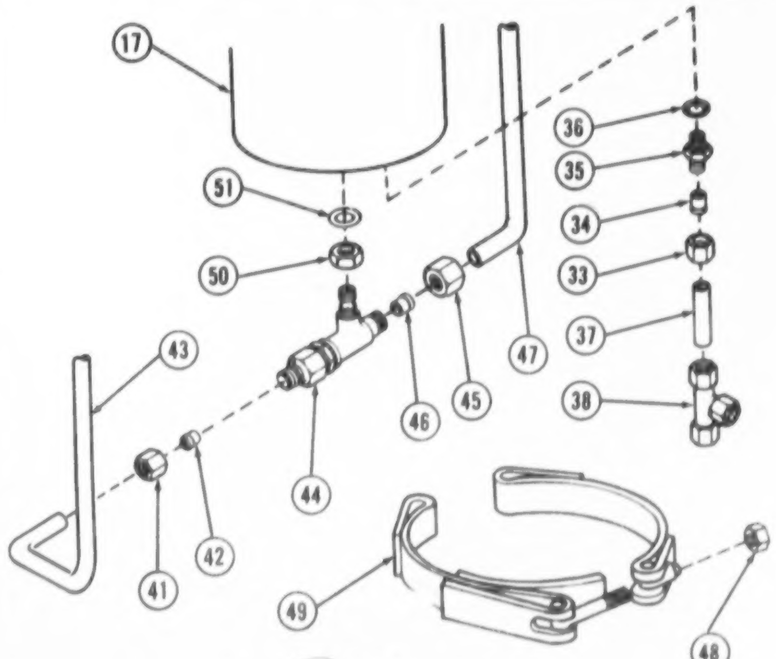
14 Loosen nut (27) on tube tee.

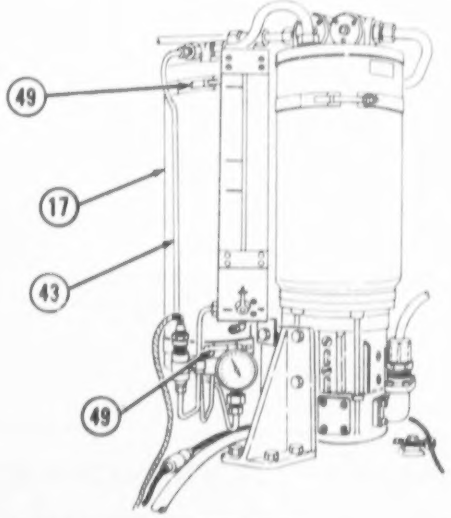
15 Remove tube (28).

16 Remove liquid indicator gage lower support screw (29) from power pack support.

17 Remove screw (30) and washer (31) from upper support and power pack.

18 Lift off liquid indicator gage (32) with elbow (39) and cap (40).





19 Remove nut (33), clinch sleeve (34), adapter (35), preformed packing (36), tube (37) and tee (38) from underside of main accumulator (17). Discard preformed packing (36).

20 Loosen nut (41) and clinch sleeve (42).

21 Disconnect return tube (43) at safety relief valve assembly (44).

22 Remove nut (45) and clinch sleeve (46).

23 Disconnect power pack to accumulator tube (47).

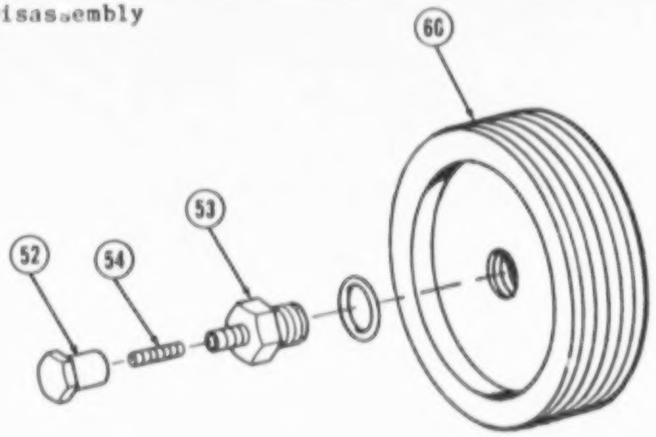
24 Support accumulator (17). Remove two nuts (48) and open clamps (49). Remove accumulator (17).

25 Remove hex nut (50), preformed packing (51) and safety relief valve assembly (44) from underside of accumulator (17). Discard preformed packing (51).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) – Continued

b. Disassembly

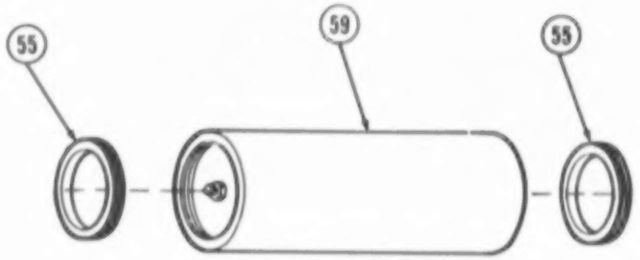


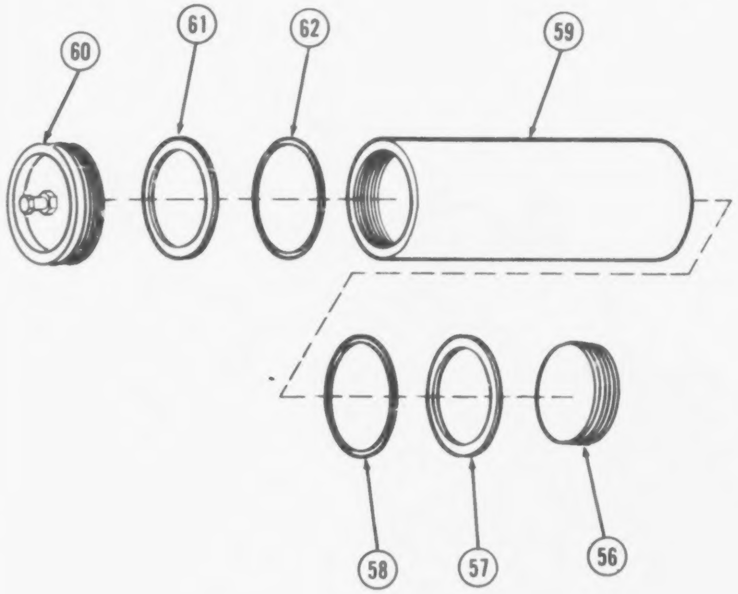
WARNING

Accumulator contains high pressure nitrogen. Pressure must be relieved before disassembly.

1 Remove pneumatic valve cap (52) from air valve body (53). Depress valve core (54) to relieve precharged nitrogen pressure.

2 Remove two external threaded rings (55), one at each end of accumulator cylinder (59).





3 Remove cylinder bottom cap (56) at bottom of accumulator cylinder (59).

4 Remove and discard preformed packing (58) and packing retainer (57) from cylinder bottom cap (56).

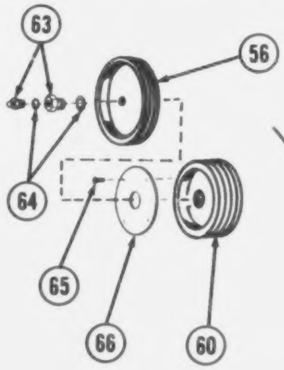
5 Remove cylinder top cap (60) from top of accumulator cylinder (59).

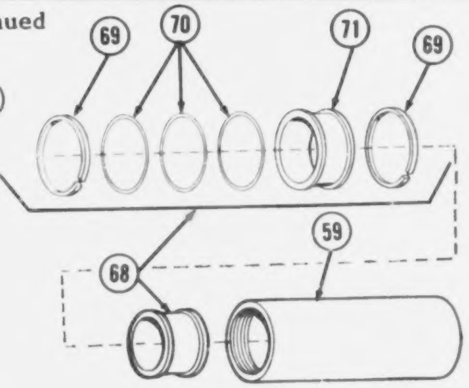
6 Remove and discard preformed packing (62) and packing retainer (61) from cylinder top cap (60).

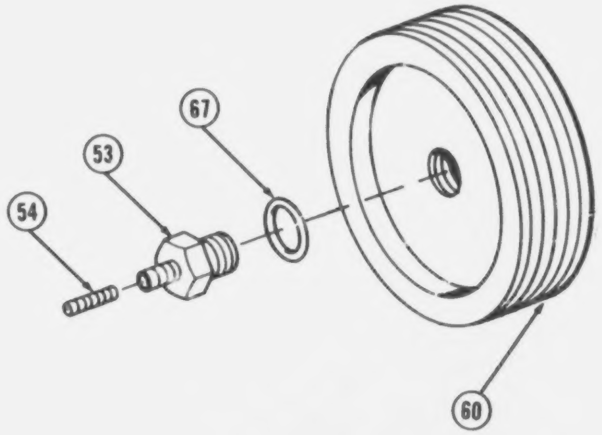
CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) — Continued

b. Disassembly-Continued







7 Remove two adapter (63) and two preformed packings (64) from cylinder bottom cap (56). Discard two preformed packings (64).

8 If instruction plate (66) is not legible and requires replacement, remove four drive screws (65) and instruction plate (66) from cylinder top cap (60).

9 Remove valve core (54), valve body (53) and preformed packing (67) from cylinder top cap (60). Discard preformed packing (67).

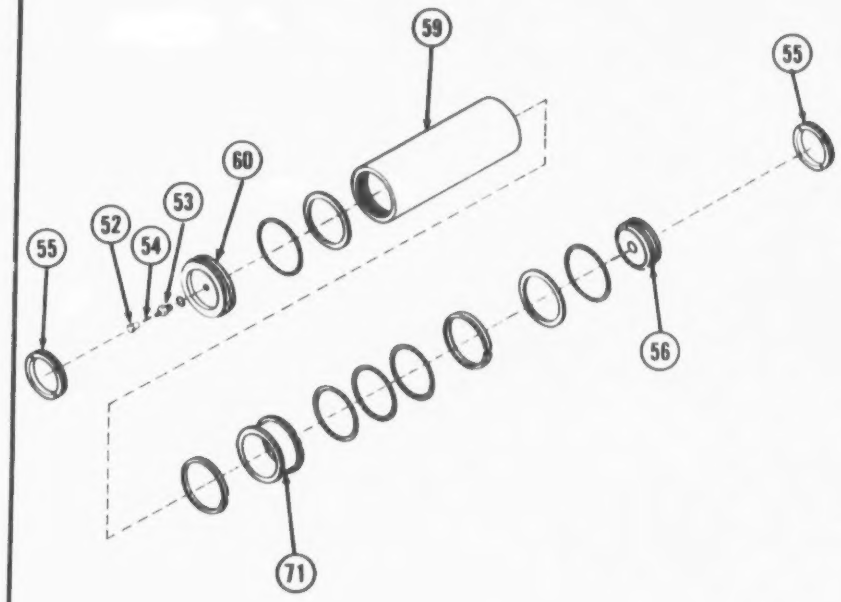
NOTE

Be careful not to scratch finished surface of piston.

10 Remove floating piston group (68) from accumulator cylinder (59).

11 Remove and discard two ring guides (69) and three piston seals (70) from piston (71).

c. Inspection



1 Inspect two external threaded rings (55). Replace if threads are damaged.

2 Inspect pneumatic valve cap (52). Replace if damaged.

3 Test valve core (54). Replace if it leaks.

4 Inspect valve body (53). Replace if damaged.

5 Inspect cylinder caps (56 and 60). Replace if damaged.

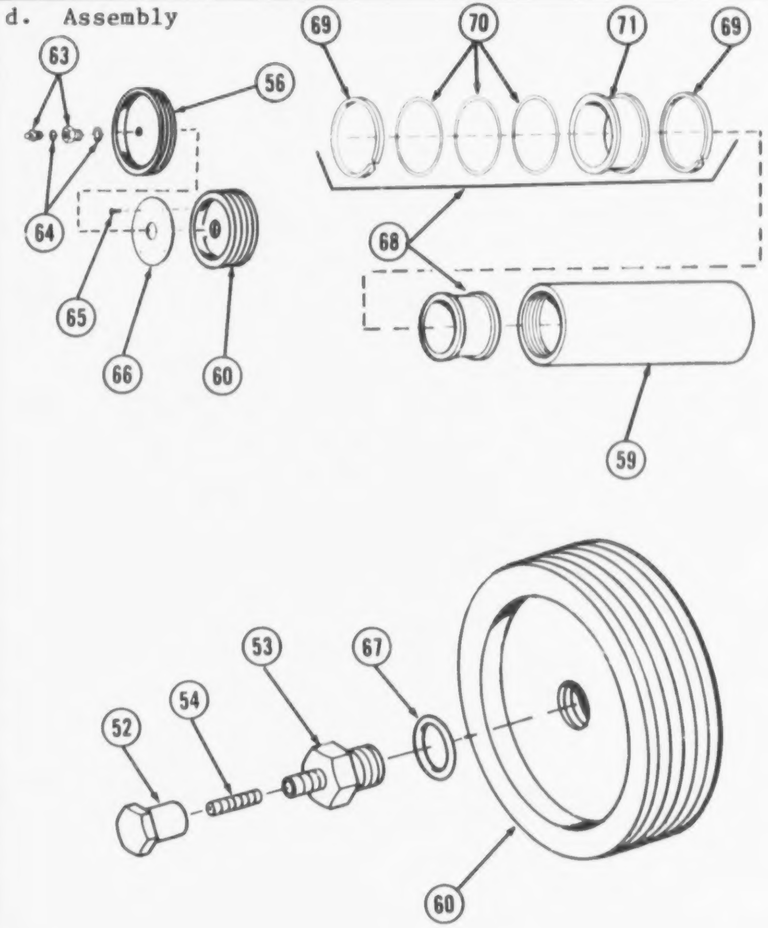
6 Inspect accumulator cylinder (59). Replace if cracked, inside is scored, or inside diameter is greater than 6.547 inches (166.2 mm).

7 Inspect piston (71). Replace if cracked or scored. Measure fit of piston (71) in accumulator cylinder (59) and replace if greater than 0.012 inch (0.3 mm).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) – Continued

d. Assembly



NOTE

Coat piston and inside of accumulator cylinder with clean hydraulic fluid (Item 10, App. C) before assembly.

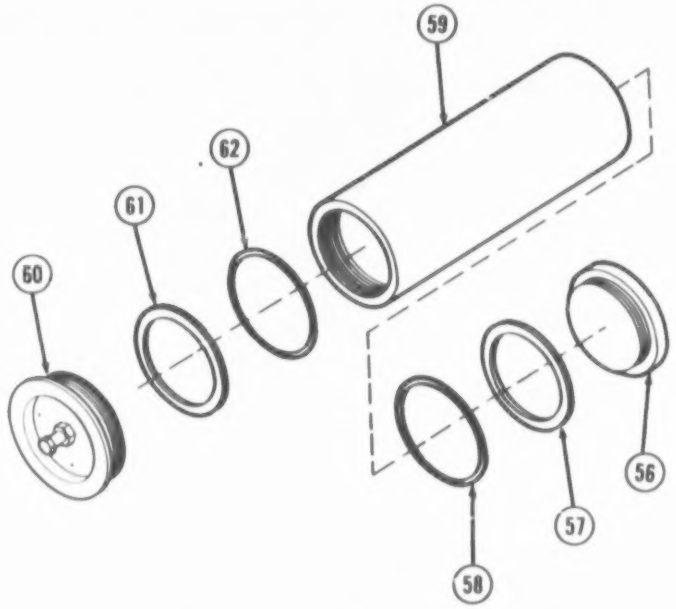
1 Install three new piston seals (70) and two new ring guides (69) on piston (71).

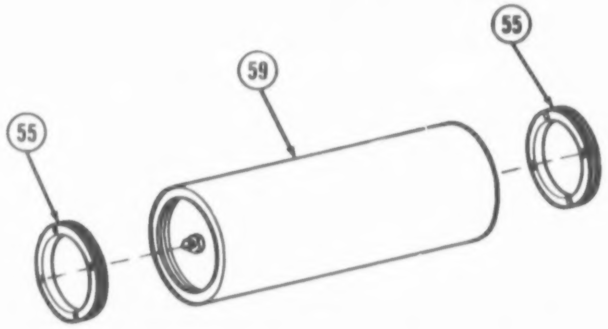
2 Being careful not to scratch finished surface of piston (71), insert floating piston group (68) into accumulator cylinder (59).

3 Install new preformed packing (67), valve body (53), valve core (54) and valve cap (52) on cylinder top cap (60).

4 If previously removed, install instruction plate (66) to cylinder top cap (60) with four drive screws (65).

5 Install two new preformed packings (64) and two adapters (63) to cylinder bottom cap (56).





6 Install new packing retainer (61) and new preformed packing (61) on cylinder top cap (60).

7 Install cylinder top cap (60) to top of accumulator cylinder (59).

8 Install new packing retainer (57) and new preformed packing (58) on cylinder bottom cap (56).

9 Install cylinder bottom cap (56) to bottom of accumulator cylinder (59).

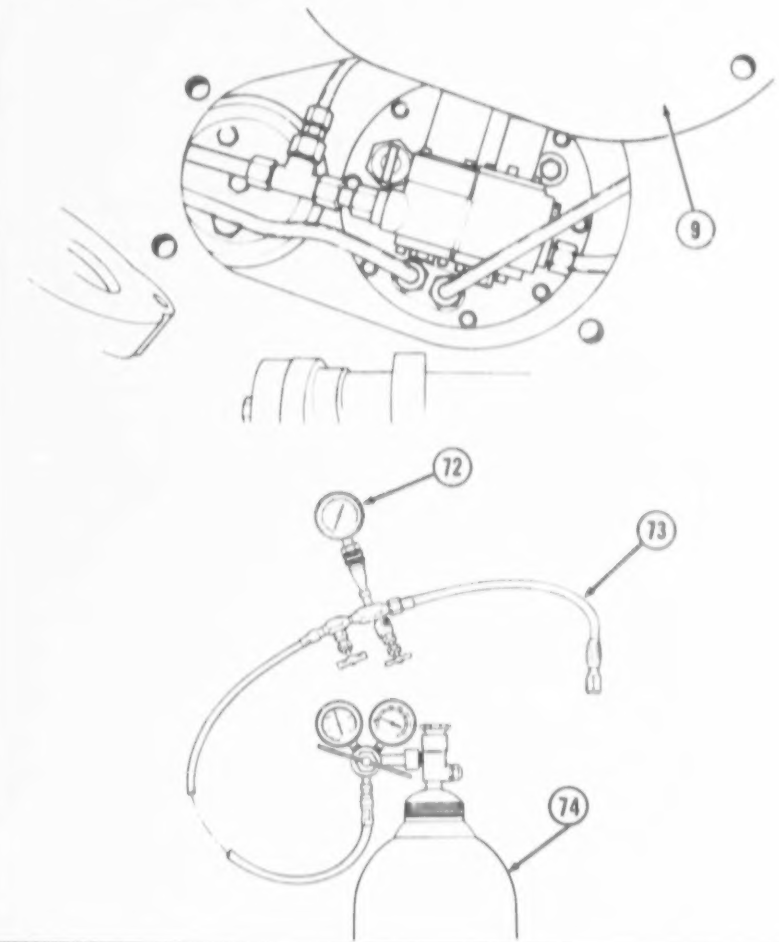
10 Install two external threaded rings (55), one at each end of accumulator cylinder (59).

11 Precharge the accumulator (ref. page 5-66).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) – Continued

e. Service (Method One)



1 Remove cab access cover (9), if accumulator is installed in cab (ref. TM 9-2350-311-20-2).

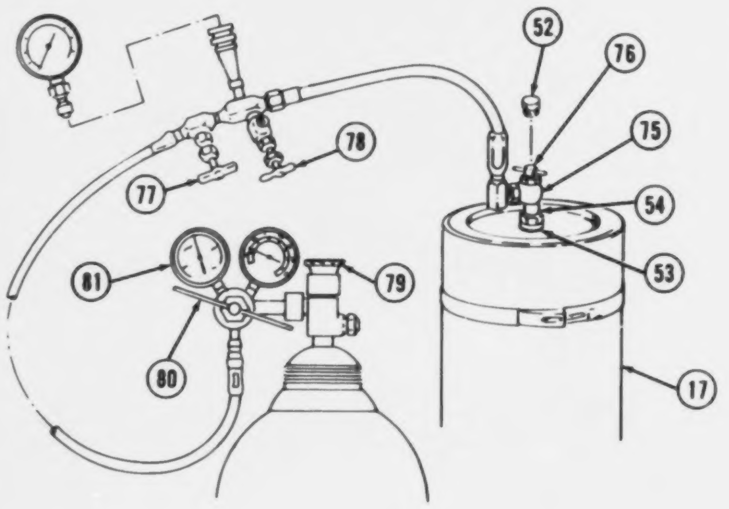
2 Discharge pressure in cab hydraulic system (ref. TM 9-2350-311-20-2).

3 Remove low pressure gage (72) from accumulator charging regulator (73) (Item 10, App. B).

WARNING

Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

4 Attach and tighten regulator charging accumulator (73) to nitrogen charging cylinder (74), as shown.



5 Remove pneumatic valve cap (52) from valve body (53). If valve body (53) cannot be reached directly when accumulator (17) is installed in cab, use extension valve accumulator charging (Item 10, App. B).

NOTE

Be sure ports in bottom cylinder cap are not blocked or plugged.

6 Attach charging device valve (75) to valve body (53, but do not tighten. Close check valve (76) of charging device valve (75) until stem no longer contacts valve core (54).

7 Open valve (77) and close valve (78). Open shutoff valve (79).

8 Open pressure regulator valve (80) until gage (81) registers 15 to 20 psi (103-137 kPa), then close pressure regulator valve (80).

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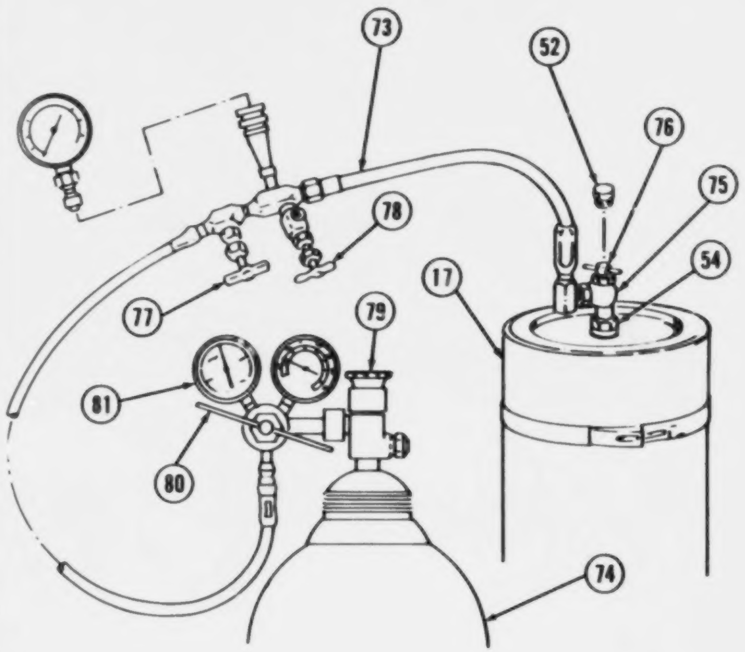
CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) – Continued

e. Service (Method One)-Continued



9 Tighten charging device valve (75) just before gage (81) registers 0 psi.

10 Open check valve (76) of charging device valve (75) clockwise to open valve core (54).

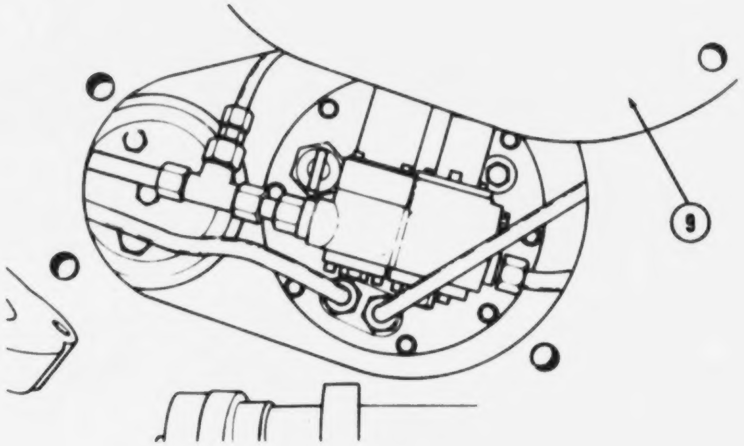
11 Open pressure regulator valve (80) by turning handle clockwise until gage (81) registers 500 to 550 psi (3447-3792 kPa).

12 Close pressure regulator valve (80) when sound of nitrogen flowing into accumulator (17) has stopped.

13 Close check valve (76) of charging device valve (75) all the way by turning counter-clockwise, thereby closing valve core (54).

14 Open valve (78) slowly to release pressure in the charging device.

15 Remove charging device valve (75) from accumulator (17).



16 Install pneumatic valve cap (52) on accumulator (17).

17 Close shutoff valve (79) by turning it clockwise.

18 Remove accumulator charging regulator (73) from nitrogen charging cylinder (74).

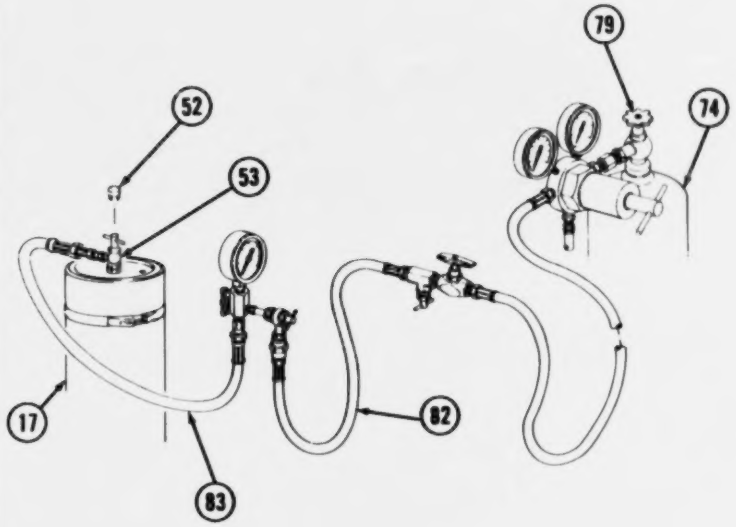
19 Charge and fill hydraulic system, if accumulator is in vehicle (ref. TM 9-2350-311-20-2).

20 Install cab access cover (9) (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) — Continued

f. Service (Method Two)



1 Remove cab access cover if accumulator is installed in cab (ref. TM 9-2350-311-20-2).

2 Discharge pressure in hydraulic system (ref. TM 9-2350-311-20-2).

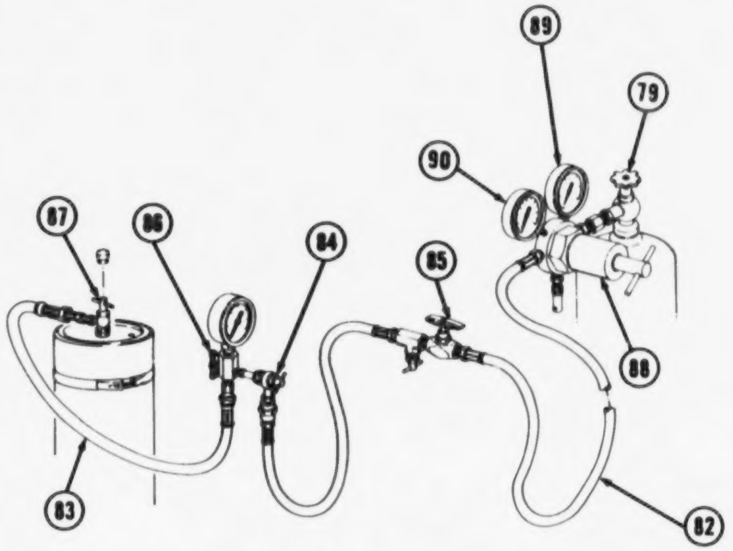
WARNING

- Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

3 Open and close shutoff valve (79) to clear valve seat of any dust or dirt. Repeat this operation after installation of pressure regulator to clear hose.

4 Connect and tighten nitrogen charging device (82) to nitrogen charging cylinder (74) as shown.

5 Remove valve cap (52). Connect nitrogen checking device (83) to valve body (53) on accumulator (17).



6 Connect nitrogen charging device (82) to nitrogen checking device (83).

7 Open valve (84).

8 Close valve (85).

9 Close bleeder valve (86).

10 Open check valve (87) by turning clockwise.

11 Close pressure regulator valve (88) by turning counterclockwise until no spring pressure is felt.

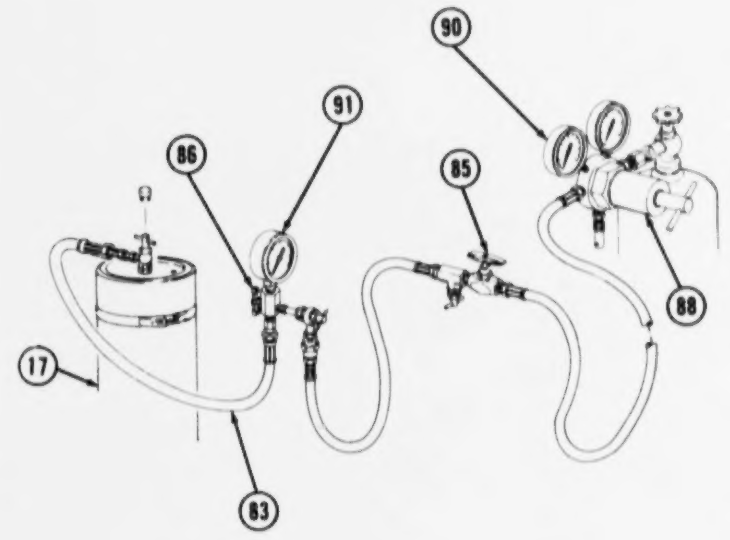
12 Open shutoff valve (79) slowly until full cylinder pressure is indicated on 4000 psi gage (89) of pressure indicator.

13 Open pressure regulator valve (88) slowly, turning it clockwise until pressure on 3000 psi gage (90) registers 50 psi (345 kPa).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) — Continued

f. Service (Method Two)-Continued



14 Open valve (85), allowing nitrogen to enter the accumulator (17) until gage (91) on the nitrogen checking device (83) reads 50 psi (345 kPa).

15 Close valve (85).

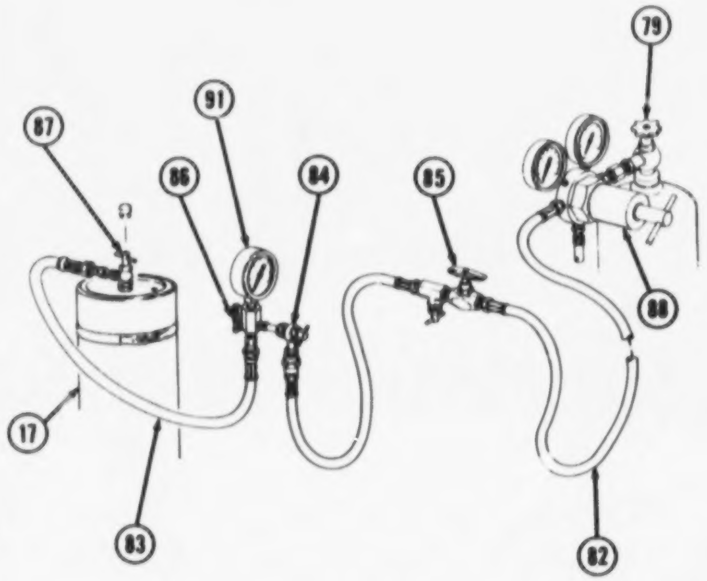
16 Open bleeder valve (86) until all nitrogen is bled from accumulator (17), then close bleeder valve (86).

17 Repeat steps 12 and 13 to remove all traces of moisture prior to charging system to full pressure. Reopen valve (85).

NOTE

Charging the system too fast will heat the dry nitrogen. This will give an inaccurate reading because the pressure will decrease when the nitrogen cools. Estimated time to charge system is 30 minutes or more. System should be charged at ambient temperature of weapon use.

18 Open pressure regulator valve (88) slowly, turning clockwise until pressure on 3000 psi gage (90) registers 550 psi (3792 kPa) at 70°F (21°C).



19 Open valve (85) slowly, allowing nitrogen to charge system. Raise pressure in 100 psi (690 kPa) increments until gage (91) stabilizes at 550 psi (3792 kPa) at 70°F (21°C).

WARNING

Failure to close check valve on main accumulator and pressure regulator valve could result in injury from high pressure in hoses of nitrogen charging device and nitrogen checking device.

20 Close check valve (87) and shutoff valve (79). Let system remain idle for one hour after charging.

WARNING

Failure to open bleeder valve could result in injury from high pressure trapped in hoses of nitrogen charging device and nitrogen checking device.

21 Open bleeder valve (86) to bleed pressure from nitrogen charging device (82) and nitrogen checking device (83).

22 Disconnect nitrogen charging device (82) and nitrogen checking device (83) at valve (84).

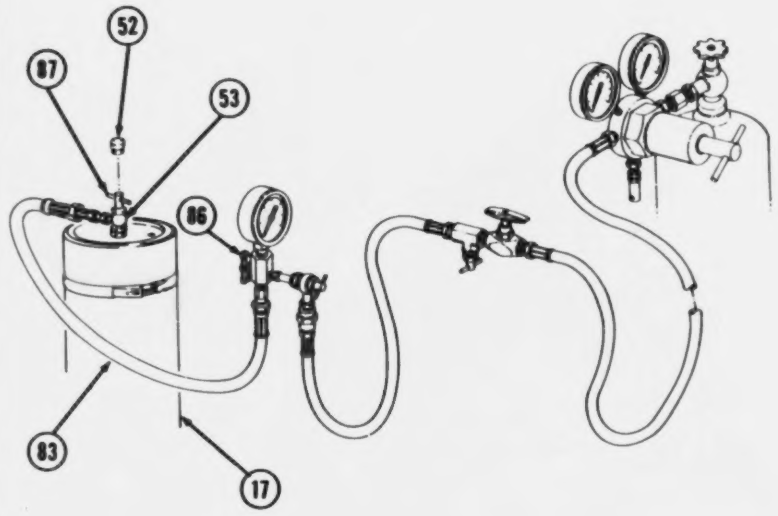
23 Close pressure regulator valve (88) by turning counterclockwise.

24 Disconnect nitrogen charging device (82) from shutoff valve (79).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) — Continued

f. Service (Method Two)-Continued



25 Close bleeder valve (86).

26 Open check valve (87).

27 Slowly open bleeder valve (86), reducing pressure to 500 psi (3447 kPa) on accumulator (17), then close bleeder valve (86).

28 Close check valve (87).

29 Open bleeder valve (86).

30 Disconnect nitrogen checking device (83) from valve body (53) on accumulator (17).

31 Replace valve cap (52).

g. Test

NOTE

The accumulator assembly (main) must be tested every time after servicing before it is installed in the vehicle. Accumulator must be charged to 500 ± 50 psi (3447 ± 345 kPa) with dry nitrogen to perform test.

1 Loosely plug ports in the bottom cylinder cap of accumulator (17).

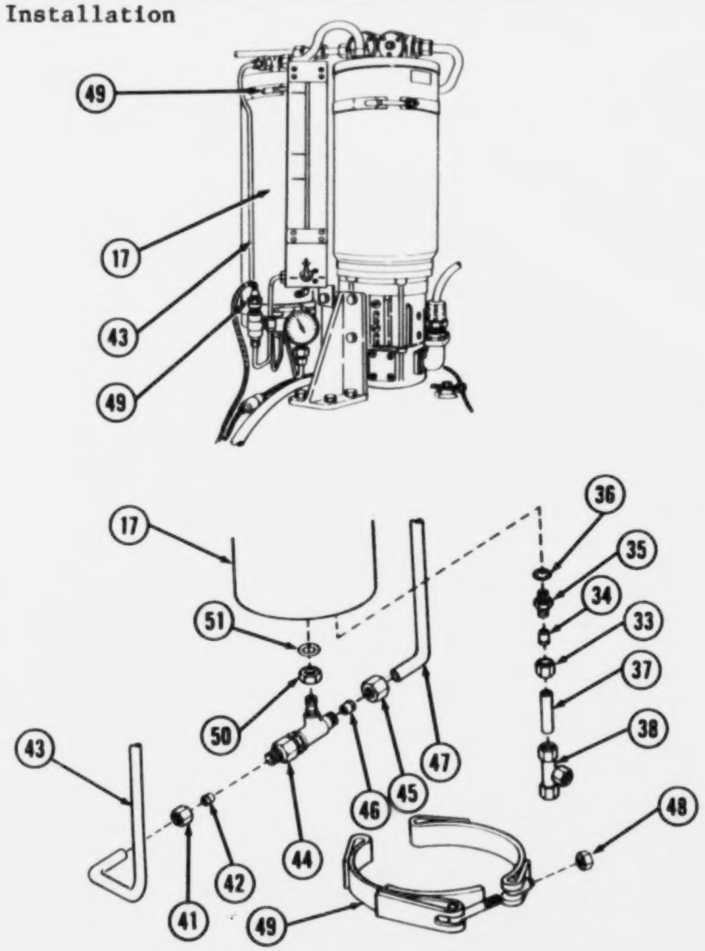
2 Submerge accumulator (17) completely in water for a period of ten minutes. There must be no evidence of leakage during this period. If there is a leakage, release nitrogen pressure, disassemble, inspect, repair, assemble, service and retest before installation in cab.

3 Remove accumulator (17) from water and dry thoroughly. If accumulator (17) is to be stored or transported, relieve all nitrogen pressure.

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) — Continued

h. Installation



1 Install safety relief valve assembly (44), new preformed packing (51) and hex nut (50) to underside of accumulator (17).

2 Position accumulator (17) in installed position and support. Install two nuts (48) and draw clamps (49) closed around accumulator (17).

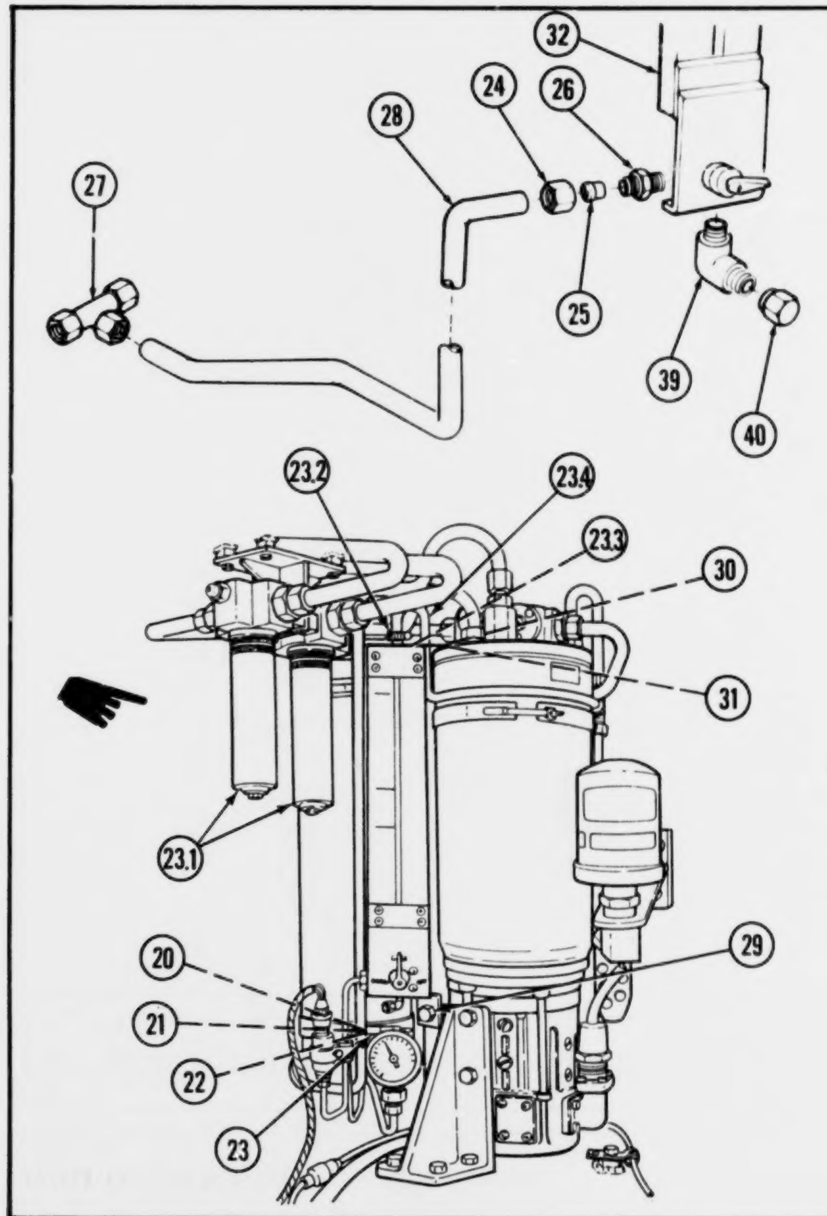
3 Connect power pack to accumulator tube (47).

4 Install clinch sleeve (46) and nut (45).

5 Connect return tube (43) at safety relief valve assembly (44).

6 Install clinch sleeve (42) and nut (41).

7 Install tee (38), tube (37), new preformed packing (36), adapter (35), clinch sleeve (34) and nut (33).



8 Place gage assembly (32), with elbow (39) and cap (40), on accumulator (17). Support gage.

9 Install washer (31) and screw (30) on upper support and power pack.

10 Install gage assembly lower support screw (29) in power pack support.

11 Install tube (28).

12 Tighten nut (27) on tube tee.

13 Install adapter (26), clinch sleeve (25) and tube coupling nut (24).

NOTE

Steps 13.1 and 13.2 apply to M109A4 howitzers only.

13.1 Install hose (23.3) on tube (23.4) and secure to liquid indicator gage using clamp (23.2).

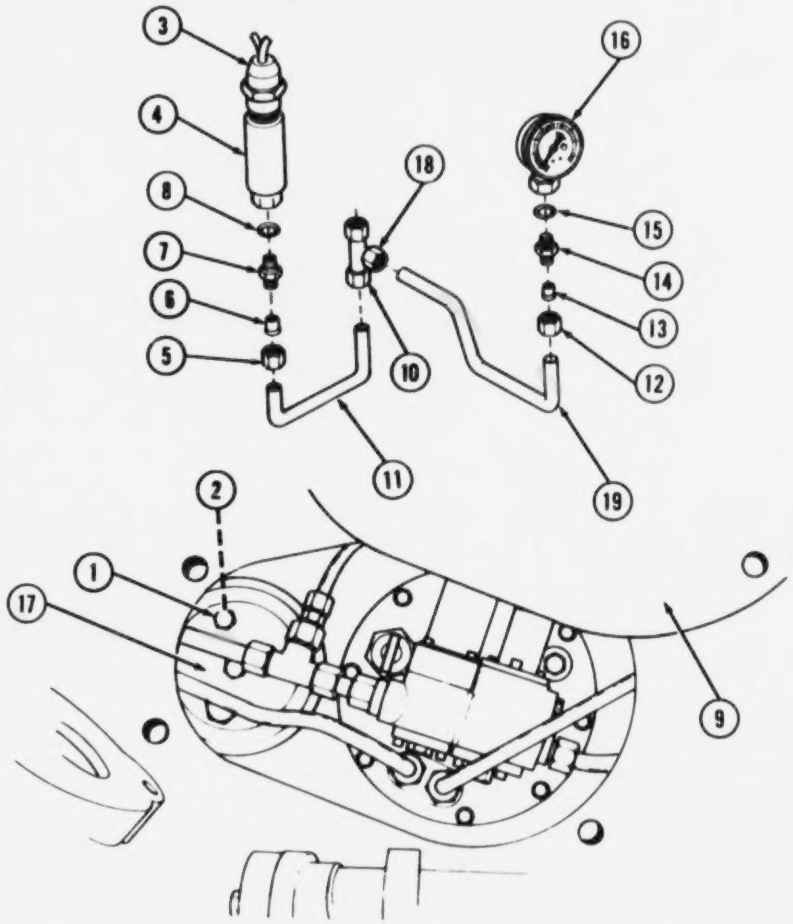
13.2 Install hydraulic filter assemblies (23.1) (ref. TM 9-2350-311-20-2).

14 Install clamp (23), new lock washer (22), nut (21) and screw (20).

CAB HYDRAULICS — Continued

5-7. ACCUMULATOR ASSEMBLY (MAIN) – Continued

h. Installation-Continued



15 Install tube (19).

16 Tighten nut (18) on tube tee.

17 Install pressure gage (16), new preformed packing (15), adapter (14), clinch sleeve (13) and tube coupling nut (12).

18 Install tube (11).

19 Tighten nut (10) on tube tee.

20 Install pressure switch (4), new preformed packing (8), straight adapter (7), clinch sleeve (6) and tube coupling nut (5).

21 Connect female plug (3) (circuit No. 645) to pressure switch (4).

22 At top of accumulator (17), turn lock screw (2) down until it engages tapped hole in accumulator (17) cap fully.

23 Tighten hex nut (1).

24 Install cab access cover (9) (ref. TM 9-2350-311-20-2).

25 Refill and charge cab hydraulic system (ref. TM 9-2350-311-20-2).

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) – Continued

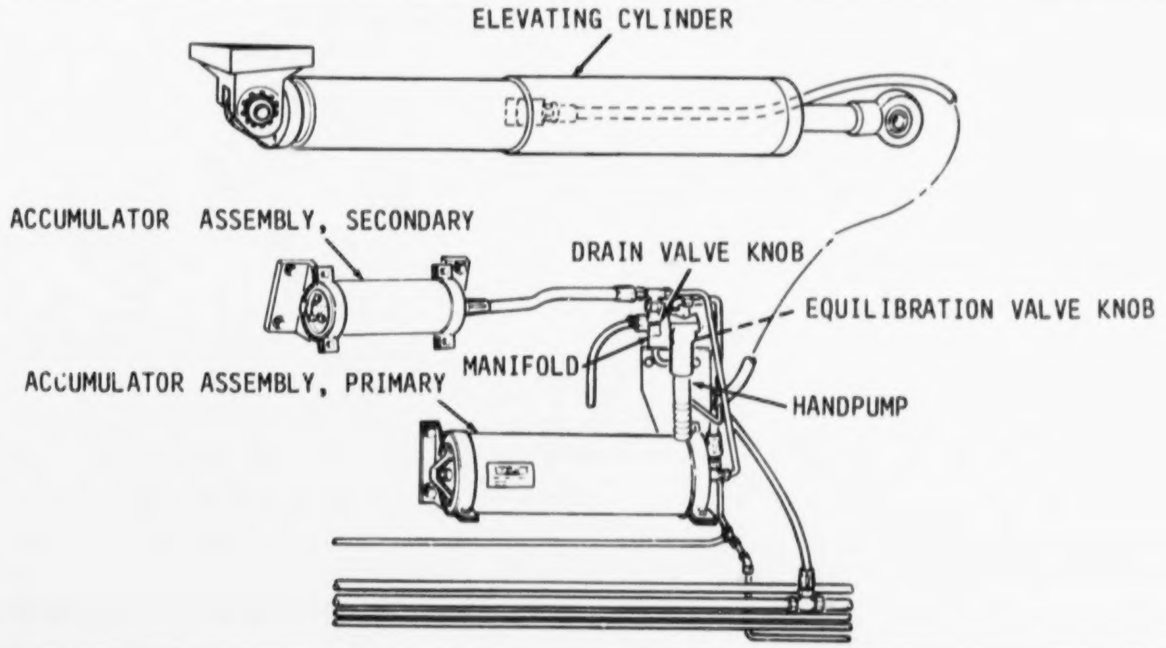
This task covers:

a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Test-Pressure (Method One)
f. Test-Pressure (Method Two)
g. Service (Method One)
h. Service (Method Two)
i. Test-Leakage
j. Installation

INITIAL SET-UP

Materials/Parts
Preformed packings
Dry nitrogen (Item 18, App. C)
Hydraulic fluid (Item 10, App. C)
Lock washers

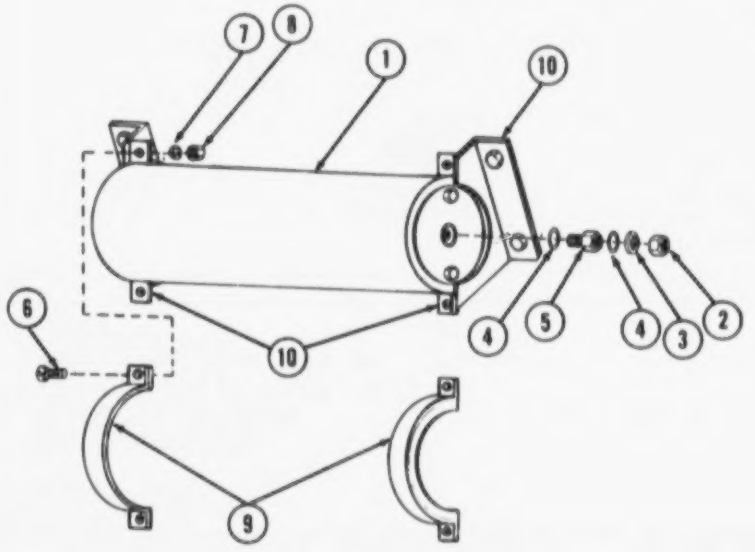
Special Tools
Accumulator charging regulator (Item 10, App. B)
Nitrogen charging kit (Item 11, App. B)


ELEVATING CYLINDER
ACCUMULATOR ASSEMBLY, SECONDARY
DRAIN VALVE KNOB
EQUILIBRATION VALVE KNOB
MANIFOLD
ACCUMULATOR ASSEMBLY, PRIMARY
HANDPUMP

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) — Continued

a. Removal



1 Discharge cab hydraulic system pressure (ref. TM 9-2350-311-20-2).

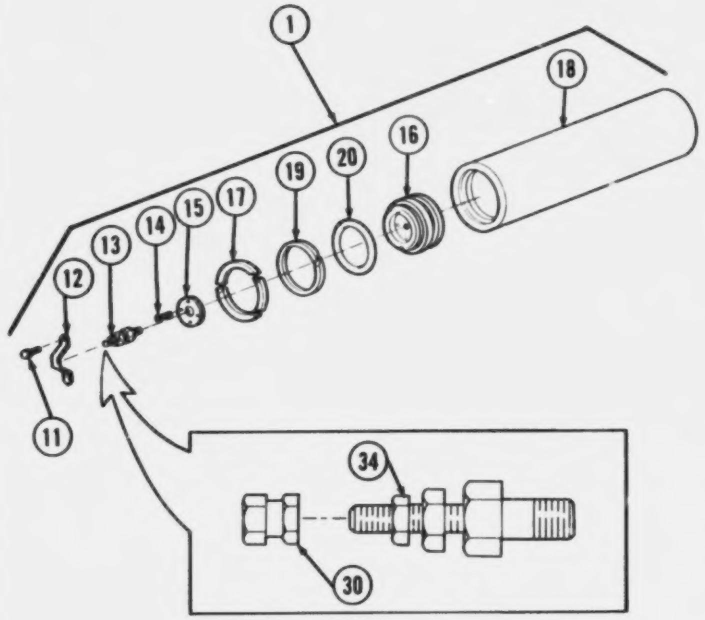
2 Disconnect lines to tube tee and remove tube tee at primary accumulator (ref. page 5-35).

3 Remove locknut (2), flat washer (3), two preformed packings (4) and bushing (5) from primary accumulator assembly (1). Discard two preformed packings (4).

4 Remove four screws (6), four lock washers (7), four nuts (8) and two straps (9) from brackets (10). Discard four lock washers (7).

5 Remove primary accumulator assembly (1).

b. Disassembly



1 Remove two hex head cap screws (11) and guard (12).

WARNING

Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

2 Remove pneumatic valve cap (30) and loosen check valve nut (34) on pneumatic valve (13) to release nitrogen precharge pressure from primary accumulator assembly (1).

3 Remove pneumatic valve (13).

4 Remove four drive screws (14) and instruction plate (15).

5 Push end (16) into cylinder (18) about one inch (25 mm) to allow three segments of ring (17) to be removed.

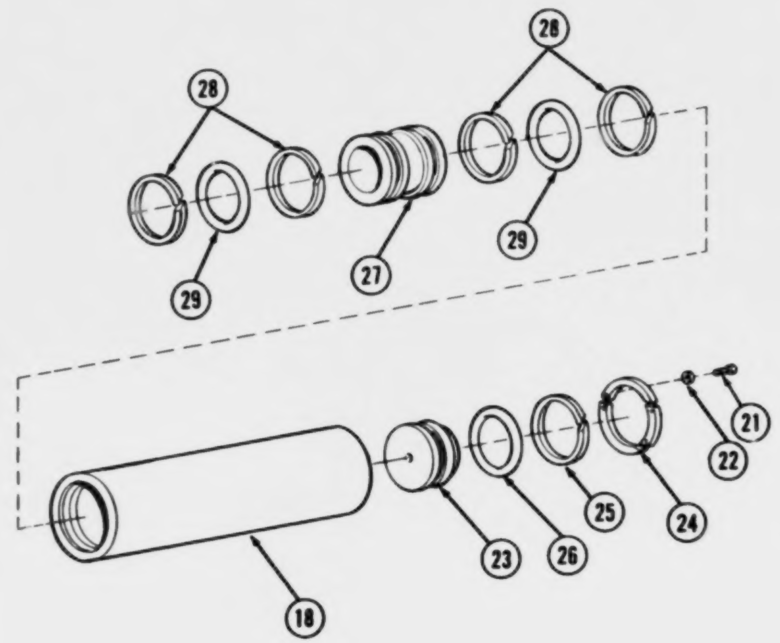
6 Remove three segments of ring (17) from groove in cylinder (18).

7 Remove packing retainer (19), preformed packing (20) and end (16) from cylinder (18). Discard preformed packing (20).

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) – Continued

b. Disassembly-Continued



8 Remove three hex head cap screws (21) and three flat washers (22) from base (23).

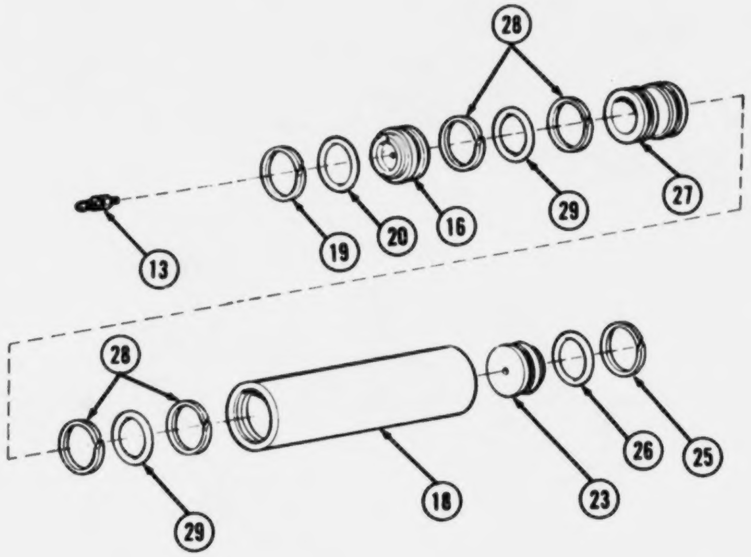
9 Push base (23) into cylinder (18) about one inch (25 mm) to allow three segments of ring (24) to be removed from groove inside cylinder (18).

10 Remove three segments of ring (24), packing retainer (25), preformed packing (26) and chassis base (23). Discard preformed packing (26).

11 Remove hydraulic piston (27) from cylinder (18). Use care to protect machined surfaces of the piston (27) and inside diameter of cylinder (18) from scratches.

12 Remove four packing retainers (28) and two preformed packings (29) from hydraulic piston (27). Discard two preformed packings (29).

c. Inspection



1 Inspect pneumatic valve (13). Replace if there is any sign of damage.

2 Inspect six packing retainers (19, 25 and 28). Replace if damaged.

3 Inspect end (16). Replace if threads are damaged, or burred at preformed packing (20) grooves.

4 Inspect hydraulic piston (27). Replace if cracked, damaged or burred at preformed packing (29) grooves.

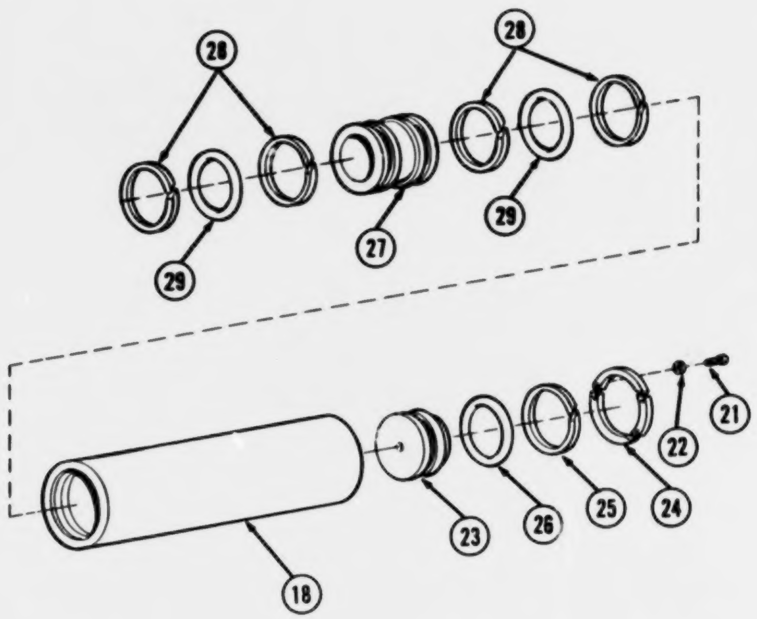
5 Inspect base (23). Replace if cracked, damaged or burred at preformed packing (26) grooves.

6 Inspect interior of cylinder (18). Replace if scratched, scored or pitted.

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) — Continued

d. **Assembly**



1 Install two new preformed packings (29) and four packing retainers (28) on hydraulic piston (27).

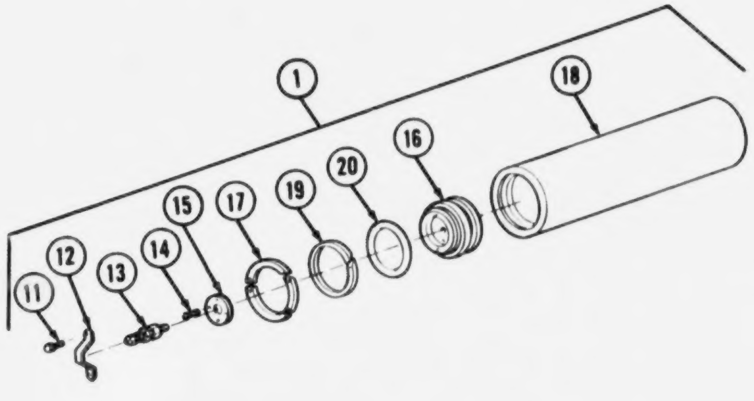
2 Coat hydraulic piston (27) with hydraulic fluid (Item 11, App. C) and carefully insert into cylinder (18).

3 Install new preformed packing (26) and packing retainer (25) on base (23).

4 Coat base (23) with hydraulic fluid (Item 10, App. C) and carefully insert into cylinder (18) far enough so that groove for ring (24) is accessible.

5 Install three segments of ring (24) in groove of cylinder (18).

6 Install three flat washers (22) and three hex head cap screws (21) to base (23).



7 Install new preformed packing (20) and packing retainer (19) on end (16).

8 Coat end (16) with hydraulic fluid (Item 11, App. C) and carefully insert into cylinder (18) far enough so that groove for ring (17) is accessible.

9 Install three segments of ring (17) in groove inside cylinder (18).

10 Install instruction plate (15) and four drive screws (14).

11 Install pneumatic valve (13).

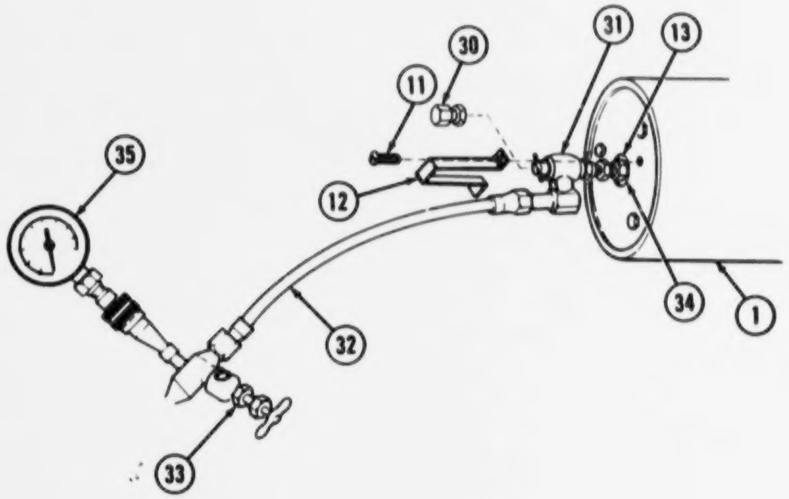
12 Charge and test accumulator assembly (primary) (1). (Ref. page 5-82.)

13 Install guard (12) and two hex head cap screws (11).

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) — Continued

e. Test-Pressure (Method One)



WARNING

Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

1 Remove two hex head cap screws (11) and guard (12).

2 Remove pneumatic valve cap (30) from pneumatic valve (13).

3 Fasten connector (31) of accumulator charging regulator (32) (Item 10, App. B) tightly to pneumatic valve (13). Be sure pressure gage (35) has a range of at least 0-2000 psi (0-13790 kPa).

4 Close valve (33).

5 Slowly loosen check valve nut (34) by turning it counterclockwise until pressure gage (35) stabilizes. Note reading. Accumulator assembly (primary) (1) is fully charged if pressure is 900 ±25 psi (6205 ± 172 kPa).

6 Tighten check valve nut (34) by turning it clockwise.

7 Slowly open valve (33) to allow gas in pressure gage (35) to escape.

8 Remove regulator charging accumulator (32) (Item 11, App. B) and connector (31).

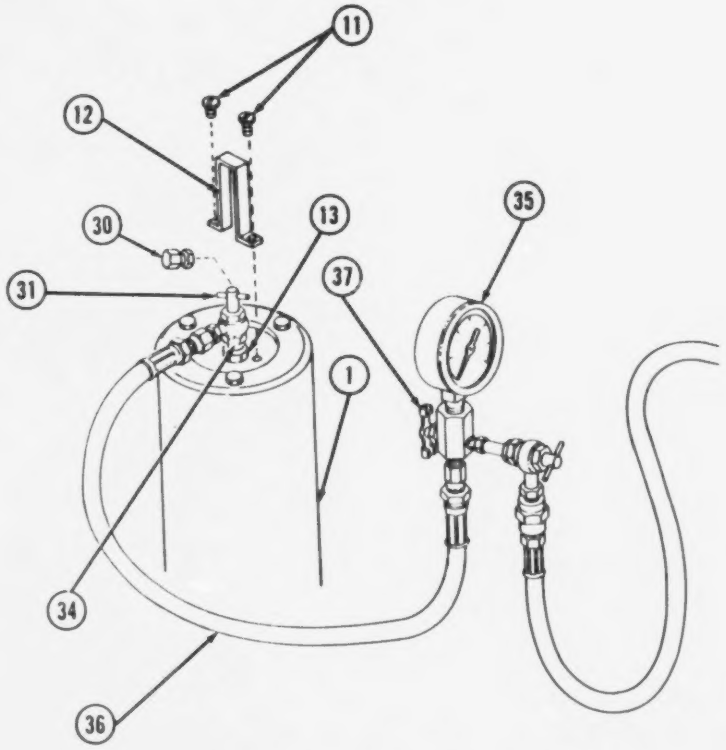
9 Install pneumatic valve cap (30) on pneumatic valve (13).

10 Install two cap screws (11) and guard (12).

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) — Continued

f. Test-Pressure (Method Two)



WARNING

Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

1 Remove two hex head cap screws (11) and guard (12).

2 Remove pneumatic valve cap (30) from pneumatic valve (13).

3 Fasten connector (31) of nitrogen pressure checking device (36) tightly to pneumatic valve (13). Be sure that pressure gage (35) has range of at least 0-2000 psi (0-13790 kPa).

4 Close bleed valve (37).

5 Slowly loosen check valve nut (34) by turning it counterclockwise until pressure gage (35) stabilizes. Note reading. Accumulator assembly (primary) (1) is fully charged if pressure is 900 ± 50 psi (6205 ± 345 kPa).

6 Tighten check valve nut (34) by turning it clockwise.

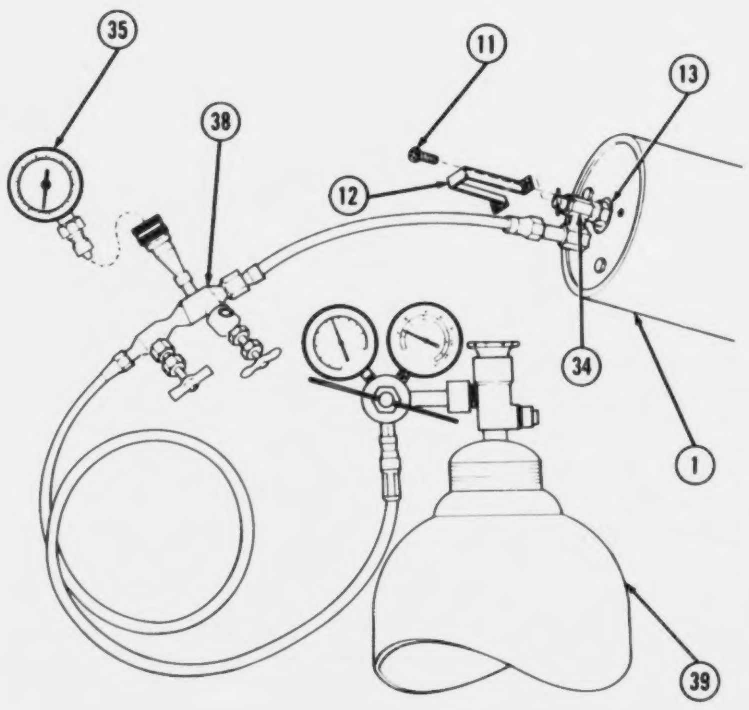
7 Slowly open bleed valve (37) to allow nitrogen in pressure gage (35) to escape.

8 Remove nitrogen pressure checking device (36) and connector (31).

9 Install pneumatic valve cap (30) on pneumatic valve (13).

10 Install guard (12) and two hex head cap screws (11).

g. Service (Method One)



NOTE

Accumulator assembly (primary) may be charged while mounted in cab. First open drain valve on manifold in equilibration system to discharge hydraulic pressure (ref. TM 9-2350-311-20-2).

1 Remove two hex head cap screws (11) and guard (12).

2 Remove accumulator assembly (primary) (1) (ref. page 5-72).

3 Discharge nitrogen pressure in accumulator assembly (primary) (1) (ref. page 5-73).

4 Obtain nitrogen charging device (38) (Item 12, App. B) and remove pressure gage (35).

WARNING

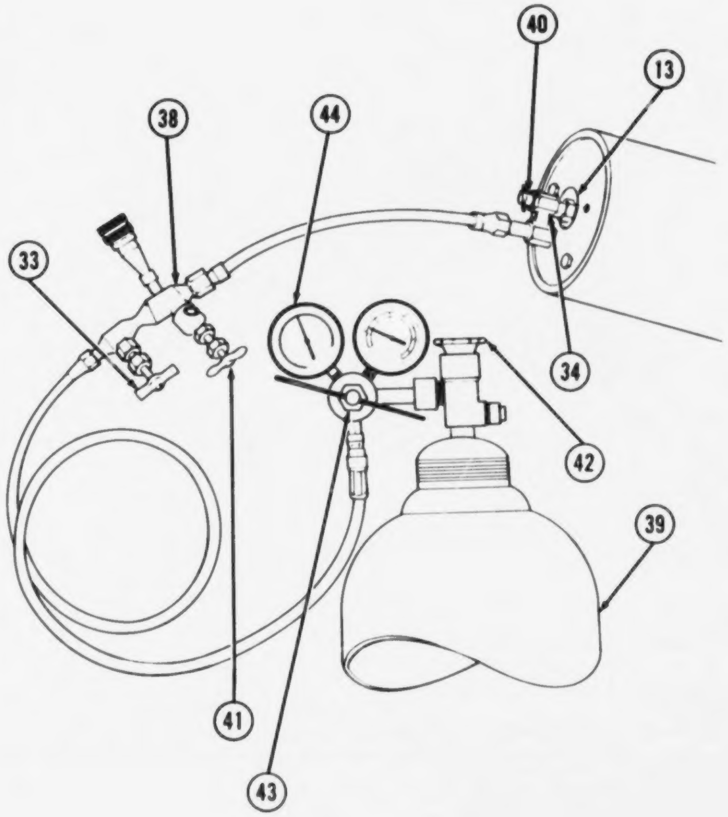
Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

5 Connect nitrogen charging device (38) (Item 11, App. B) to accumulator assembly (primary) (1) and nitrogen charging cylinder (39).

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) — Continued

g. Service (Method One)-Continued



6 Attach valve (40) of nitrogen charging device (38) (Item 12, App. B) to pneumatic valve (13), but do not tighten valve (40). Close valves (33 and 41).

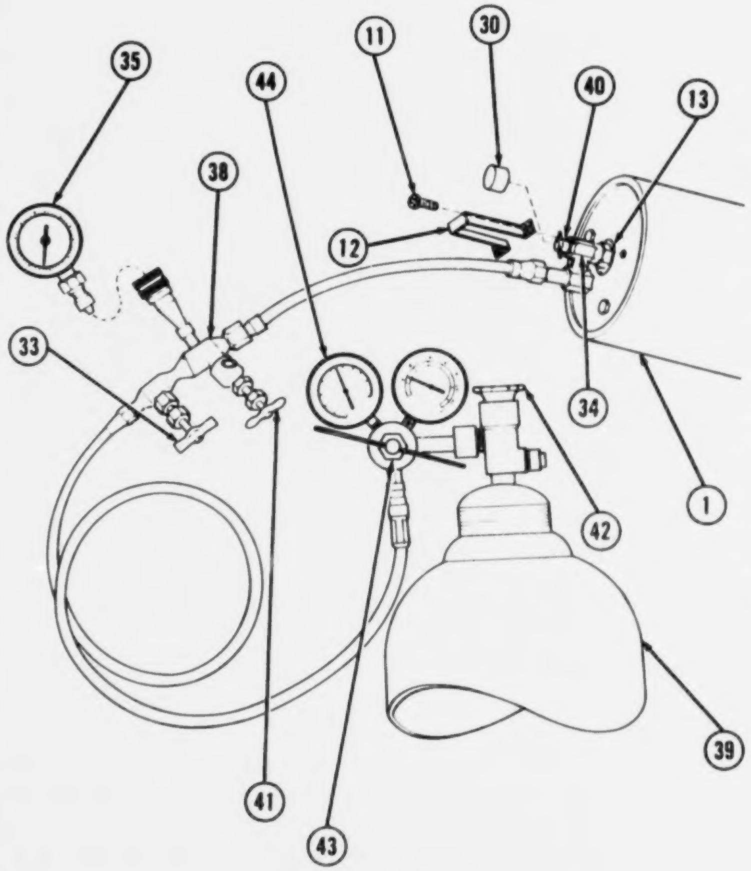
7 Open shutoff valve (42) on nitrogen charging cylinder (39).

8 Slowly open pressure regulator valve (43) until gage (44) shows 15-20 psi (103-138 kPa). Close pressure regulator valve (43).

9 Open valve (33) on nitrogen charging device (38) (Item 11, App. B). Tighten valve (40) just before gage (44) register 0 psi (0 kPa).

10 Loosen check valve nut (34) approximately one turn (2-1/4 turns is fully open).

11 Open pressure regulator valve (43) until gage (44) registers 900 ± 50 psi (6205 ± 345 kPa).



12 Tighten check valve nut (34) when sound of nitrogen flow has stopped.

13 Close pressure regulator valve (43).

14 Slowly open valve (41) to release pressure in nitrogen charging device (38) (Item 11, App. B). Remove valve (40) from pneumatic valve (13).

15 Install pneumatic valve cap (30) on pneumatic valve (13).

16 Close shutoff valve (42) on nitrogen charging cylinder (39).

17 Remove nitrogen charging device (38) (Item 11, App. B) from nitrogen charging cylinder (39) and accumulator assembly (primary) (1).

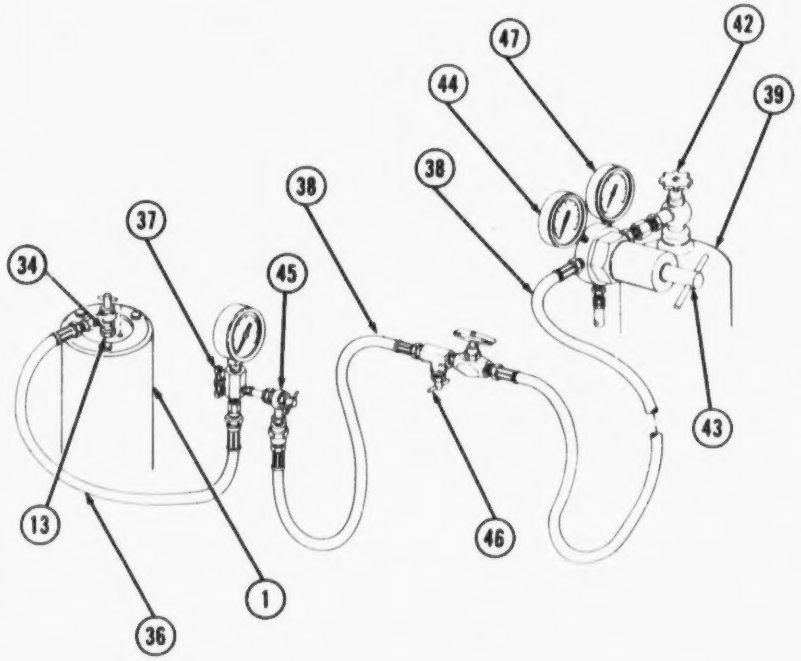
18 Install pressure gage (35) on nitrogen charging device (38) (Item 11, App. B).

19 Install guard (12) and two hex head cap screws (11).

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) – Continued

h. Service (Method Two)



WARNING

Be sure charging cylinder contains only dry nitrogen (Item 18, App. C) Certain other gases will cause cylinder or accumulator to explode.

1 Open and close nitrogen charging cylinder (39) shutoff valve (42) to clear shutoff valve (42) seat of any dust or dirt.

2 Connect and tighten nitrogen charging device (38) (Item 11, App. B) to nitrogen charging cylinder (39), as shown. Repeat operation to clear nitrogen charging device (38) (Item 12, App. B) hose.

3 Connect nitrogen pressure checking device (36) to pneumatic valve (13) on accumulator assembly (primary) (1).

4 Connect nitrogen charging device (38) (Item 11, App. B) to nitrogen pressure checking device (36).

5 Open valve (45).

6 Close valve (46).

7 Close bleed valve (37).

8 Open pneumatic valve (13) on accumulator assembly (primary) (1) by turning check valve nut (34) counterclockwise.

9 Turn pressure regulator valve (43) counterclockwise until no spring pressure is felt.

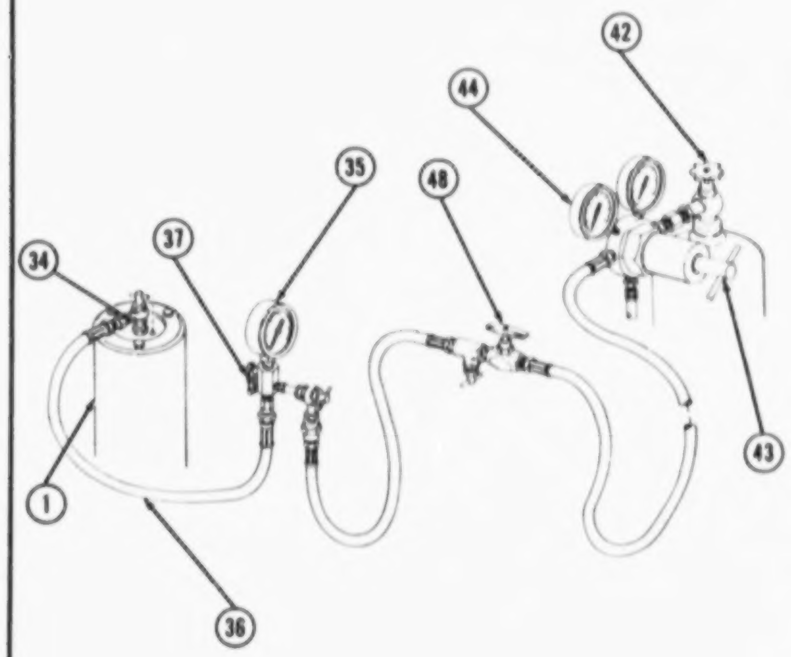
10 Open nitrogen charging cylinder (39) shutoff valve (42) slowly until full cylinder pressure is indicated on 4000 psi (27580 kPa) gage (47) of pressure regulator valve (43).

11 Open pressure regulator valve (43) slowly, turning clockwise until pressure on 3000 psi (20685 kPa) gage (44) reads 50 psi (345 kPa).

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) – Continued

h. Service (Method Two)-Continued



12 Open valve (48), allowing dry nitrogen (Item 18, App. C) to enter accumulator assembly (primary) (1) until pressure gage (35) on nitrogen pressure checking device (36) reads 50 psi (345 kPa). Close valve (48).

13 Open bleed valve (37) until all dry nitrogen (Item 18, App. C) is bled from accumulator assembly (primary) (1). Close bleed valve (37).

14 Repeat steps 11 and 12 to remove all traces of moisture prior to charging system to full pressure with dry nitrogen (Item 18, App. C).

CAUTION

Charging system too fast will heat dry nitrogen (Item 18, App. C). This will give inaccurate reading because pressure will decrease when nitrogen cools.

15 Open pressure regulator valve (43) slowly turning clockwise until pressure on 3000 psi (20685 kPa) gage (44) reads 950 psi (6550 kPa) at 70°F (21°C).

NOTE

Estimated time required to charge system is 30 minutes or more. System should be charged at ambient temperature of weapon.

16 Open valve (48) slowly, allowing dry nitrogen (Item 18, App. C) to charge system Raise pressure in 100 psi (690 kPa) increments until pressure gage (35) on nitrogen pressure checking device (36) stabilizes at 950 psi (6550 kPa) at 70°F (21°C).

WARNING

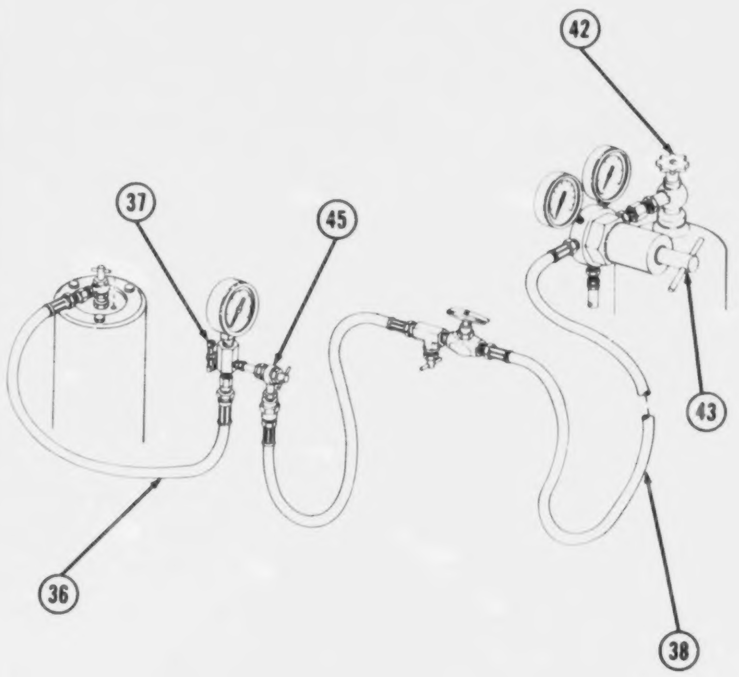
Failure to close pneumatic valve nut on accumulator assembly (primary) could result in injury to personnel from high pressure gas.

17 Close check valve nut (34) and nitrogen charging cylinder shutoff valve (42). Let system remain idle for at least one hour after charging.

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) — Continued

h. Service (Method Two)-Continued



WARNING

Failure to open bleeder valve could result in injury from high pressure trapped in hoses.

18 Open bleed valve (37) to bleed pressure from nitrogen charging device (38) (Item 11, App. B) and nitrogen pressure checking device (36).

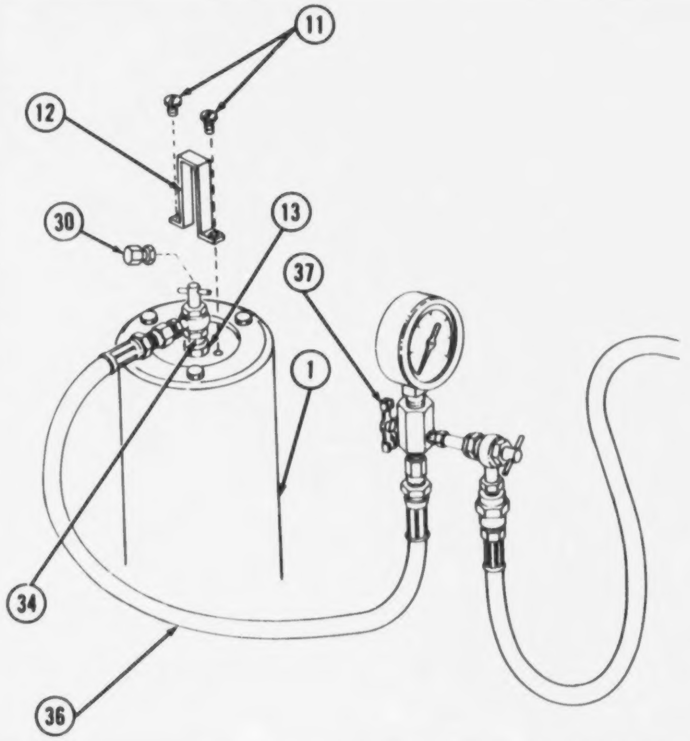
19 Disconnect nitrogen charging device (38) (Item 11, App. B) and nitrogen pressure checking device (36) at valve (45).

20 Close pressure regulator valve (43) by turning counterclockwise.

21 Disconnect nitrogen charging device (38) (Item 11, App. B) from nitrogen cylinder shutoff valve (42).

22 Close bleed valve (37).

23 Open check valve nut (34).



24 Slowly open bleed valve (37), reducing pressure to 900 psi (6205 kPa). Close bleed valve (37).

25 Close check valve nut (34) by turning clockwise.

26 Open bleed valve (37).

27 Disconnect nitrogen pressure checking device (36) from pneumatic valve (13).

28 Install valve cap (30) on pneumatic valve (13).

29 Install two cap screws (11) and guard (12).

i. Test-Leakage

1 Plug hydraulic tube hole in accumulator assembly (primary) (1).

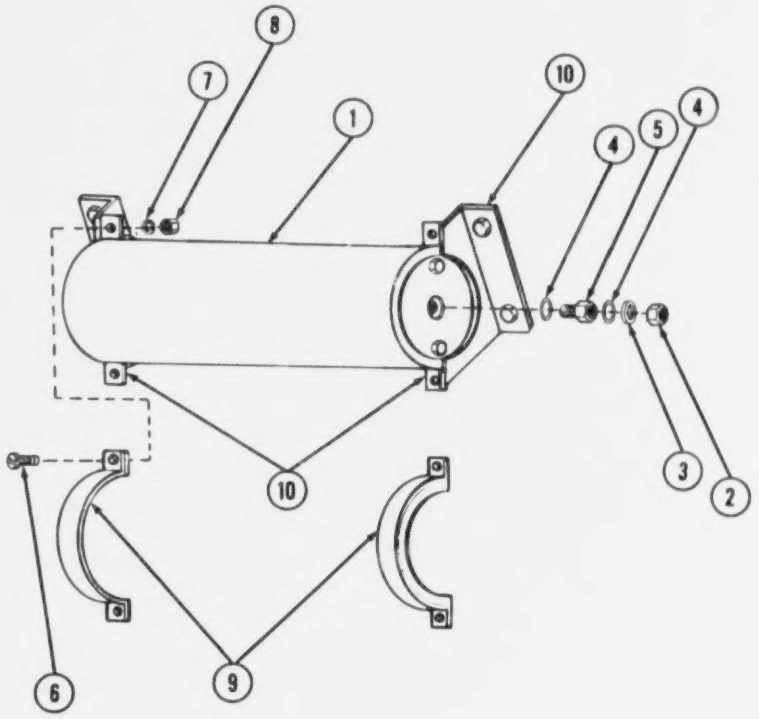
2 Submerge accumulator assembly (primary) (1) completely in water for at least ten minutes. There must be no evidence of leakage during entire period.

3 If accumulator assembly (primary) (1) leaks, it must be rebuilt or replaced.

CAB HYDRAULICS — Continued

5-8. ACCUMULATOR ASSEMBLY (PRIMARY) – Continued

j. Installation



1 Position accumulator assembly (primary) (1) in brackets (10).

2 Install two straps (9), four nuts (8), four lock washers (7) and four screws (6) to secure accumulator assembly (primary) (1) on brackets (10).

3 Install bushing (5), two new preformed packings (4), flat washer (3) and locknut (2) on accumulator assembly (primary) (1).

4 Install lines to tube tee and remove tee at primary accumulator (ref. page 5-35).

5 Fill and charge cab hydraulic system (ref. TM 9-2350-311-20-2).

5-9. ACCUMULATOR ASSEMBLY (SECONDARY)

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Test-Pressure
f. Service
g. Test-Leakage
h. Installation

INITIAL SET-UP

Materials/Parts

- Preformed packings
- Dry nitrogen (Item 19, App.C)
- Hydraulic fluid (Item 11, App. C)
- Lock washers

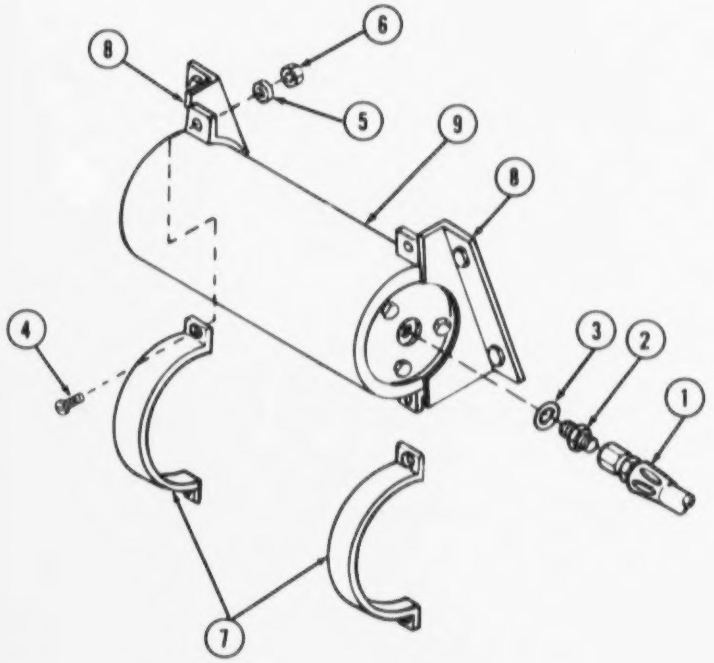
Special Tools

- Accumulator charging regulator (Item 10, App. B)
- Nitrogen charging kit (Item 11, App. B)

CAB HYDRAULICS — Continued

5-9. ACCUMULATOR ASSEMBLY (SECONDARY) — Continued

a. Removal



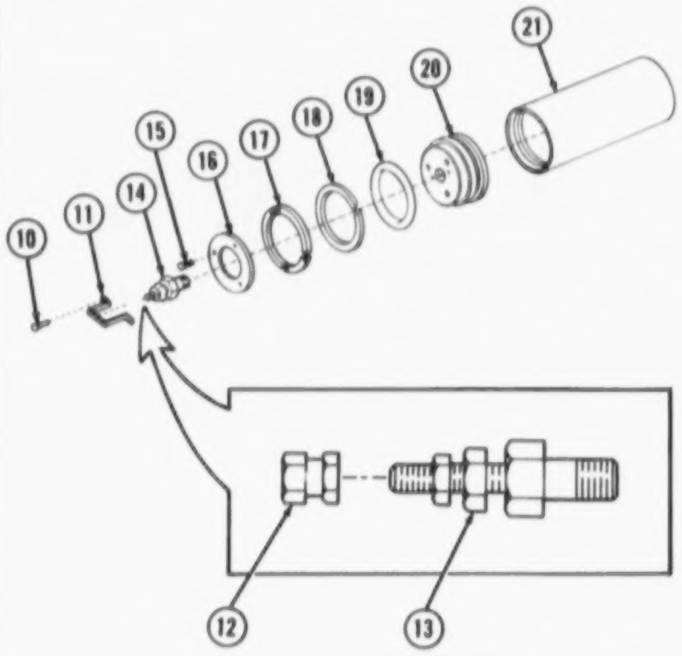
1 Discharge cab hydraulic system pressure (ref. TM 9-2350-311-20-2).

2 Remove hose connector (1), reducer (2) and preformed packing (3) from secondary accumulator assembly (9). Discard preformed packing (3).

3 Remove four screws (4), four lock washers (5), four nuts (6) and two straps (7) from brackets (8). Discard four lock washers (5).

4 Remove secondary accumulator assembly (9).

b. Disassembly



1 Remove two machine screws (10) and guard (11).

WARNING

Accumulator contains high pressure nitrogen. Use caution when handling and working with it.

2 Remove cap (12) of pneumatic valve (14). Loosen check valve nut (13) on pneumatic valve (14) to release nitrogen pre-charge pressure from accumulator assembly (secondary).

3 Remove pneumatic valve (14).

4 Remove three hex head cap screws (15) and piston stop plate (16).

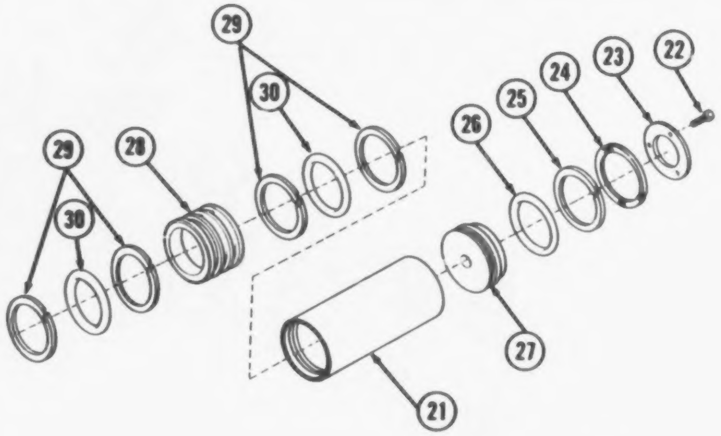
5 Push head (20) into cylinder (21) about one inch (25 mm) to permit segments of ring (17) to be removed from groove on inside of cylinder (21).

6 Remove three segments of ring (17), packing retainer (18), preformed packing (19) and head (20) from cylinder (21). Discard preformed packing (19).

CAB HYDRAULICS — Continued

5-9. ACCUMULATOR ASSEMBLY (SECONDARY) – Continued

a. Disassembly-Continued



7 Remove three hex head cap screws (22) and hydraulic piston stop plate (23).

8 Push base (27) into cylinder (21) about one inch (25mm) to permit segments of ring (24) to be removed from groove on inside of cylinder (21).

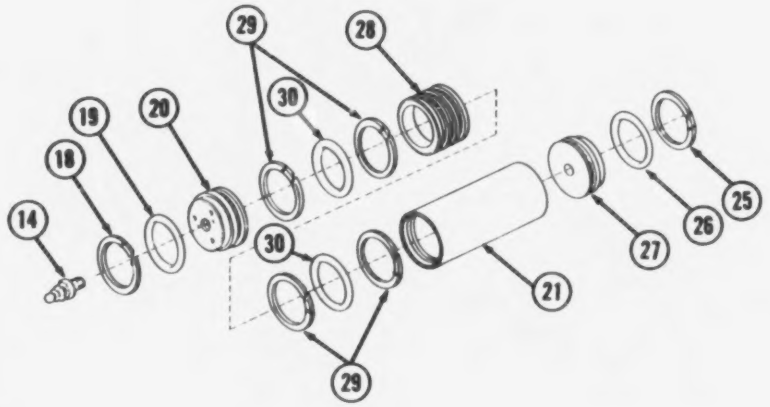
9 Remove three segments of ring (24) from groove inside cylinder (21).

10 Remove packing retainer (25), preformed packing (26) and base (27). Discard preformed packing (26).

11 Remove hydraulic piston (28) from cylinder (21).

12 Remove four packing retainers (29) and two preformed packings (30) from hydraulic piston (28). Discard preformed packings (30).

c. Inspection



1 Inspect pneumatic valve (14). Replace if damaged.

2 Inspect six packing retainers (18, 25 and 29). Replace if damaged.

3 Inspect head (20). Replace if threads are damaged or there are burrs around preformed packing (19) grooves.

4 Inspect base (27). Replace if burred at grooves for preformed packing (26).

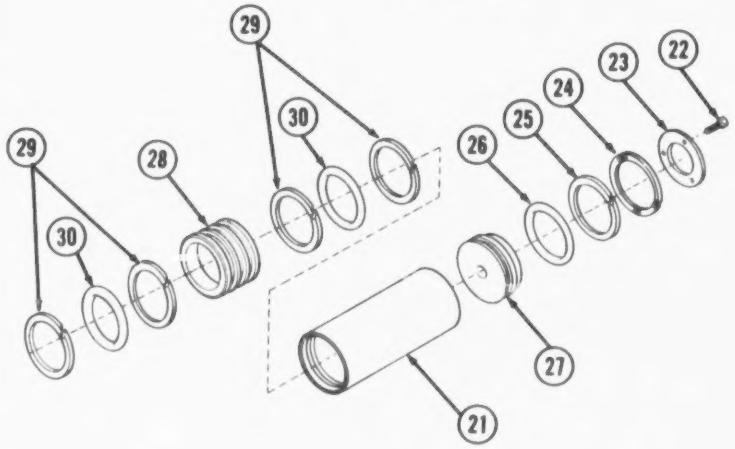
5 Inspect hydraulic piston (28). Replace if cracked, scratched, scored, damaged, deformed or if preformed packing (30) grooves are burred.

6 Inspect cylinder (21). Replace if cracked, distorted or interior is scratched or scored.

CAB HYDRAULICS — Continued

5-9. ACCUMULATOR ASSEMBLY (SECONDARY) — Continued

d. Assembly



1 Install two new preformed packings (30) and four packing retainers (29) on hydraulic piston (28).

2 Coat hydraulic piston (28) with hydraulic fluid (Item 10, App. C). Carefully insert into cylinder (21).

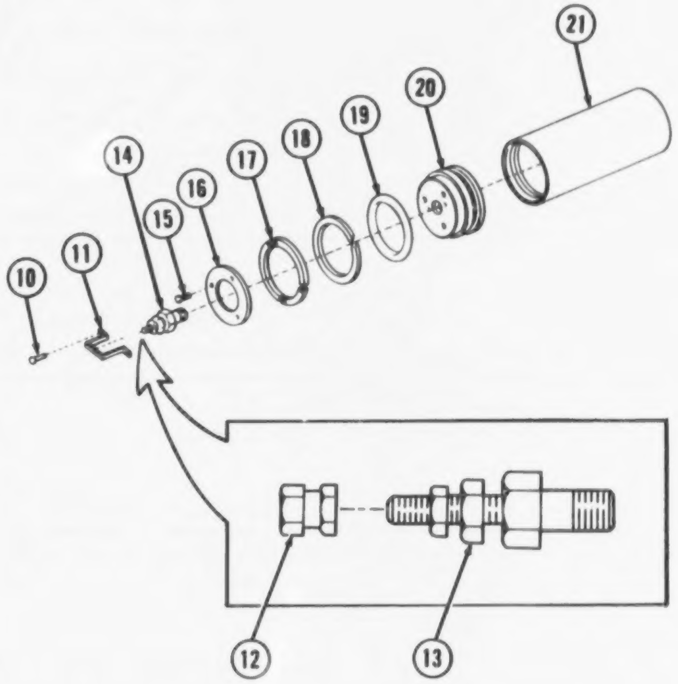
3 Install new preformed packing (26) and packing retainer (25) on base (27).

4 Coat base (27) with hydraulic fluid (Item 10, App. C). Insert into cylinder (21), being careful not to scratch finished surfaces of cylinder (21) or base (27). Push base (27) far enough into cylinder (21) so that grove for ring (24) is exposed.

5 Install three segments of ring (24) in groove inside cylinder (21).

6 Install piston stop plate (23) and secure with three hex head cap screws (22).

d. Assembly-Continued



7 Install new preformed packing (19) and packing retainer (18) on head (20).

8 Coat head (20) with hydraulic fluid (Item 10, App. C). Insert into cylinder (21), being careful not to scratch finished surfaces. Push head (20) far enough into cylinder (21) so that groove for ring (17) is accessable.

9 Install three segments of ring (17).

10 Install piston stop plate (16) and fasten to head (20) with three hex head cap screws (15).

11 Install pneumatic valve (14). Tighten check valve nut (13).

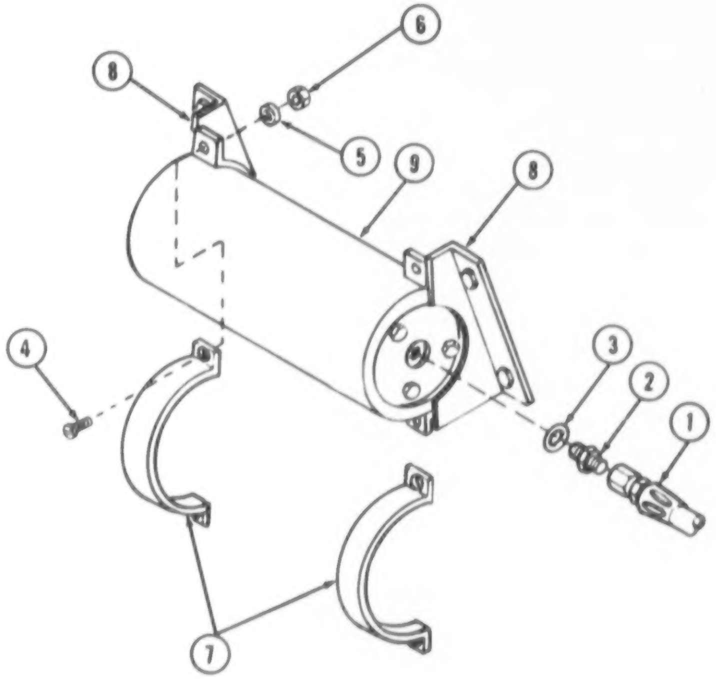
12 Install cap (12), guard (11) and two machine screws (10) after charging and testing secondary accumulator assembly (9).

CAB HYDRAULICS — Continued

5-9. ACCUMULATOR ASSEMBLY (SECONDARY) – Continued

e. Test-Pressure	Ref. page 5-82. Fully charged pressure of secondary accumulator asssembly (1) is 1500 ± 50 psi (1034 ± 345 kPa).
f. Service	Ref. page 5-88 for charging procedure, but charge secondary accumulator assembly (1) to 1500 ± 50 psi (1034 ± 345 kPa).
g. Test-Leakage	Ref. page 5-86 for test procedure.

h. Installation



1 Position secondary accumulator assembly (9) in brackets (8).

2 Secure secondary accumulator assembly (9) to brackets (8) with two straps (7), four nuts (6), four new lock washers (5) and four screws (4).

3 Install new preformed packing (3), reducer (2) and hose connector (1) to secondary accumulator assembly (9).

4 Refill, charge and bleed hydraulic system (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

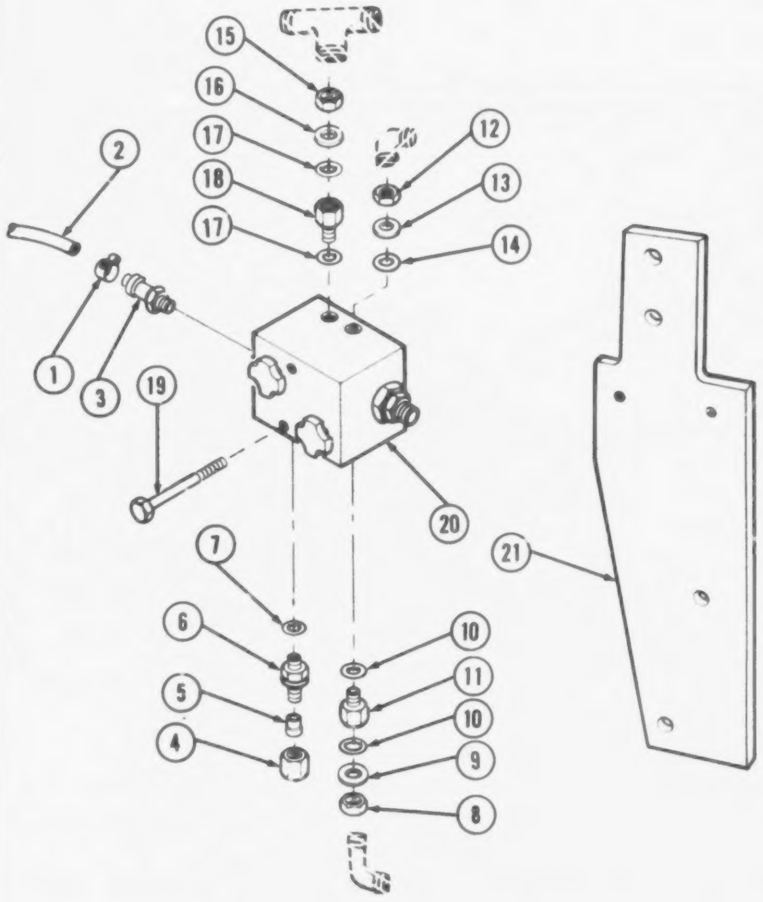
5-10. EQUILIBRATION MANIFOLD ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection
d. Assembly e. Adjustment f. Installation

INITIAL SET-UP

Materials/Parts
- Hydraulic fluid (Item 10, App. C)
- Suitable hydraulic component plugs and fittings
- Preformed packings
- Relief valve repair kit P/N 11784005
- Retainer
- Lock wires

a. Removal



1 Discharge pressure in cab hydraulic system. (ref. TM 9-2350-311-20-2).

2 Discharge equilibration system (ref. TM 9-2350-311-20-2).

3 Remove clamp (1), drain hose (2) and adapter (3).

4 Remove nut (4), sleeve (5), check valve (6) and preformed packing (7). Discard preformed packing (7).

5 Remove locknut (8), flat washer (9), two preformed packings (10) and straight adapter (11). Discard two preformed packings (10).

6 Remove nut (12), ring (13) and preformed packing (14). Discard preformed packing (14).

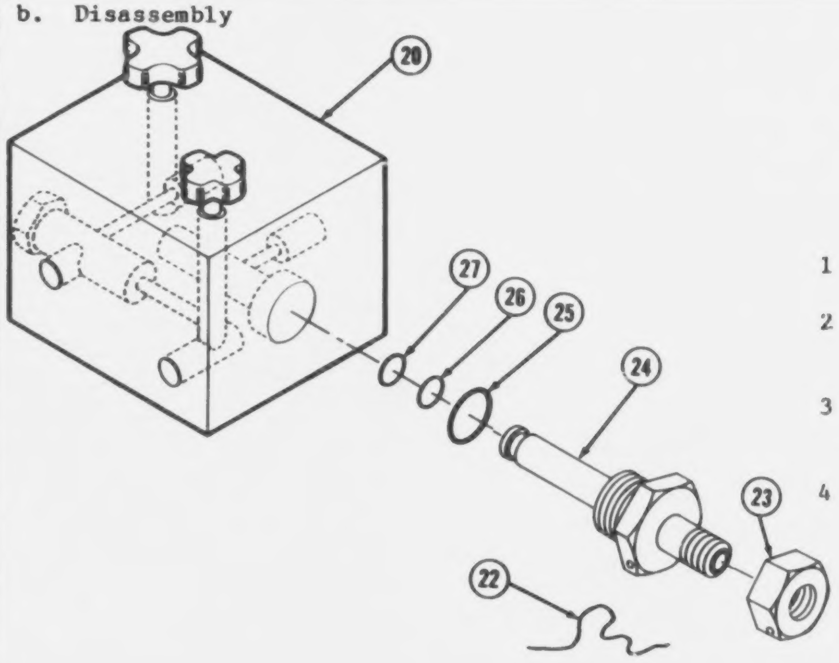
7 Remove locknut (15), flat washer (16), two preformed packings (17) and straight adapter (18). Discard two preformed packings (17).

8 Remove two hex head caps crews (19) and equilibration manifold assembly (20) from mounting plate (21).

CAB HYDRAULICS — Continued

5-10. EQUILIBRATION MANIFOLD ASSEMBLY – Continued

b. Disassembly



NOTE

Do not disassemble relief valve unless there has been leakage.

1 Remove and discard lockwire (22).

2 Remove outer nut (23) from valve assembly (24).

3 Remove valve assembly (24) from equilibrator manifold assembly (20).

4 Remove and discard preformed packing (25), retainer (26) and preformed packing (27) from valve assembly (24).

c. Inspection

1 Inspect equilibrator manifold assembly (20). Replace if cracked or damaged.

2 Inspect valve assembly (24). Replace if distorted, cracked or threads damaged.

d. Assembly

1 Install new preformed packing (27), new retainer (26) and new preformed packing (25) on valve assembly (24).

2 Coat valve assembly (24) with hydraulic fluid (Item 10, App. C). Carefully install in equilibrator manifold assembly (20).

3 Install outer nut (23) on valve assembly (24).

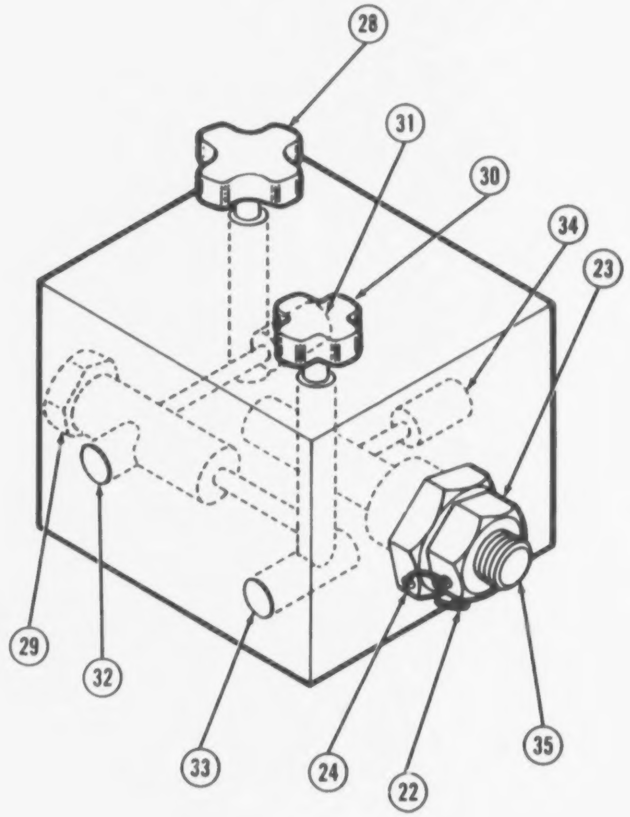
4 Make relief valve adjustment. (Ref. page 5-108.)

5 Install new lock wire (22) to secure outer nut (23) to valve assembly (24).

CAB HYDRAULICS — Continued

5-10. EQUILIBRATION MANIFOLD ASSEMBLY — Continued

e. Adjustment



NOTE

Be careful not to get dirt or other foreign material into valve ports.

1 Turn drain valve (28) clockwise to close drain port (29).

2 Open equilibrator valve (30).

3 Plug ACC port (31) and MANPUMP port (32).

WARNING

Hydraulic fluid flow from RET port will be under high pressure. Use caution to prevent serious injury.

4 Connect hose to RET port (34) and direct flow into a suitable container.

5 Apply hydraulic pressure to PRESSURE port (33) increasing from 0 psi to 3300 psi (0 kPa to 22754 kPa). Valve assembly (24) should open at 3200 ± 100 psi (22064 kPa ± 690). Opening of valve assembly (24) is indicated by flow from RET port (34). If opening pressure of valve assembly (24) must be adjusted, perform steps 6 thru 10.

6 If adjustment of valve assembly (24) is required, remove lock wire (22).

7 Loosen outer nut (23) by turning counterclockwise.

8 To increase opening pressure, rotate adjusting screw (35) clockwise with a hex key. To decrease opening pressure, rotate adjusting screw (35) counterclockwise.

9 Tighten outer nut (23).

10 Measure valve assembly (24) opening pressure (step 5). Repeat steps 5 thru 10 as necessary until opening pressure of 3200 ± 100 psi (22064 kPa ± 690) is obtained.

NOTE

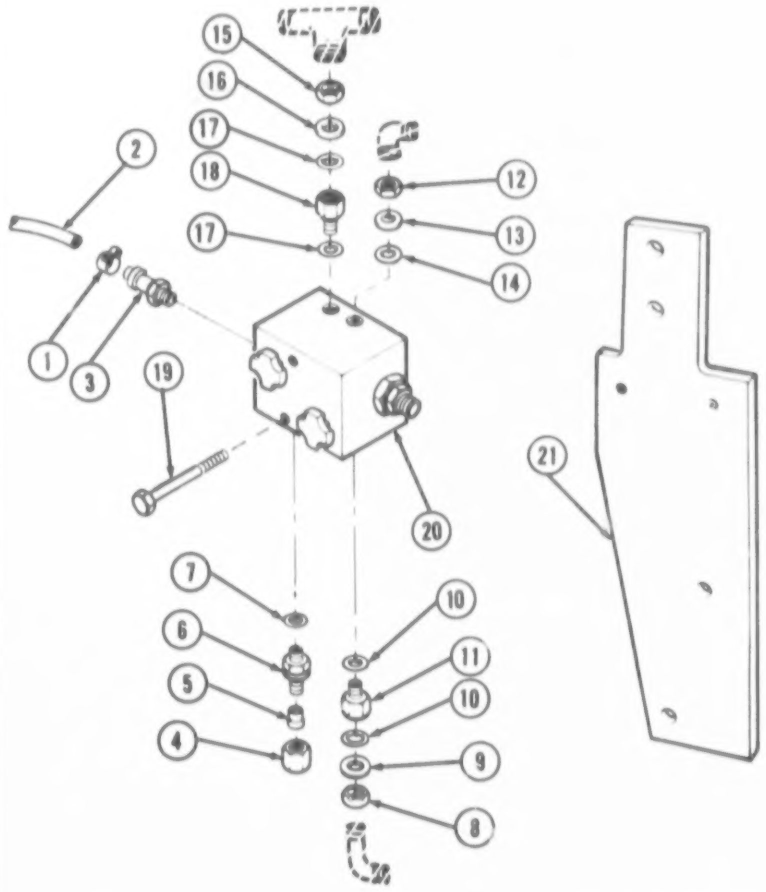
If valve assembly is defective, replace complete manifold assembly.

11 When proper pressure setting is obtained, install new lock wire (22) to secure outer nut (23) to valve assembly (24).

CAB HYDRAULICS — Continued

5-10. EQUILIBRATION MANIFOLD ASSEMBLY – Continued

f. Installation



1 Install equilibration manifold assembly (20) to mounting plate (21) with two hex head cap screws (19).

2 Install straight adapter (18), two new preformed packings (17), flat washer (16) and locknut (15).

3 Install new preformed packing (14), ring (13) and nut (12).

4 Install straight adapter (11), two new preformed packings (10), flat washer (9) and locknut (8).

5 Install new preformed packing (7), check valve (6), sleeve (5) and nut (4).

6 Install adapter (3), drain hose (2) and clamp (1).

7 Fill and charge and bleed equilibration system (ref. TM 9-2350-311-20-2).

8 Fill and charge and bleed cab hydraulic system (ref. TM 9-2350-311-20-2).

5-11. EQUILIBRATION HANDPUMP ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation

INITIAL SET-UP

Materials/Parts

Preformed packing

Lock washers

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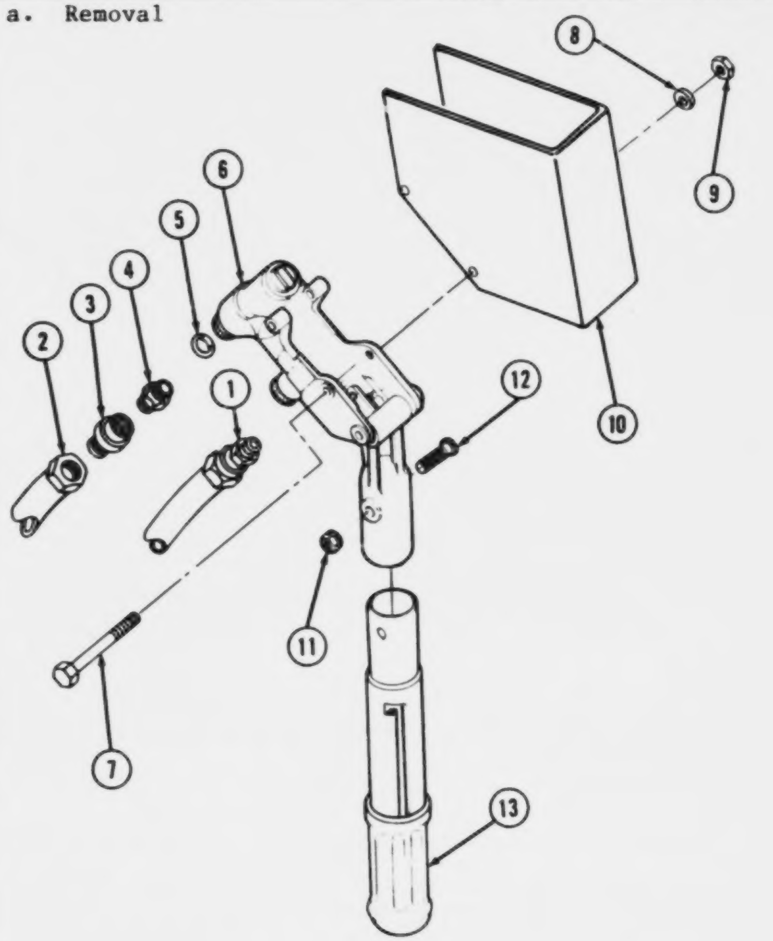
CAB HYDRAULICS — Continued

5-11. EQUILIBRATION HANDPUMP ASSEMBLY – Continued

a. Removal



1 Discharge cab hydraulic system (ref. TM 9-2350-311-20-2).

2 Discharge equilibration system (ref. TM 9-2350-311-20-2).

3 Remove adapter (1), nut (2), sleeve (3), reducer (4) and preformed packing (5) at hydraulic pump (6). Discard preformed packing (5).

4 Remove two screws (7), two lock washers (8) and two nuts (9) from mounting bracket (10). Discard two lock washers (8).

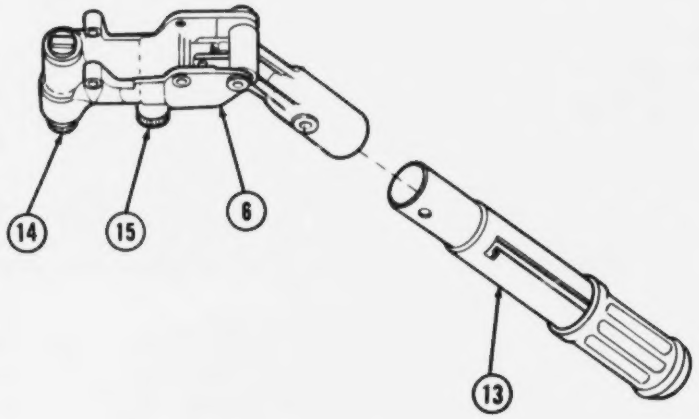
5 Remove hydraulic pump (6).

b. Disassembly

1 Remove nut (11) and screw (12).

2 Separate handle assembly (13) from hydraulic pump (6).

c. Inspection



1 Inspect handle assembly (13). Replace if cracked, distorted or damaged.

2 Inspect hydraulic pump (6). Replace if not operable, or if threads to suction port (14) or pressure port (15) are damaged.

CAB HYDRAULICS — Continued

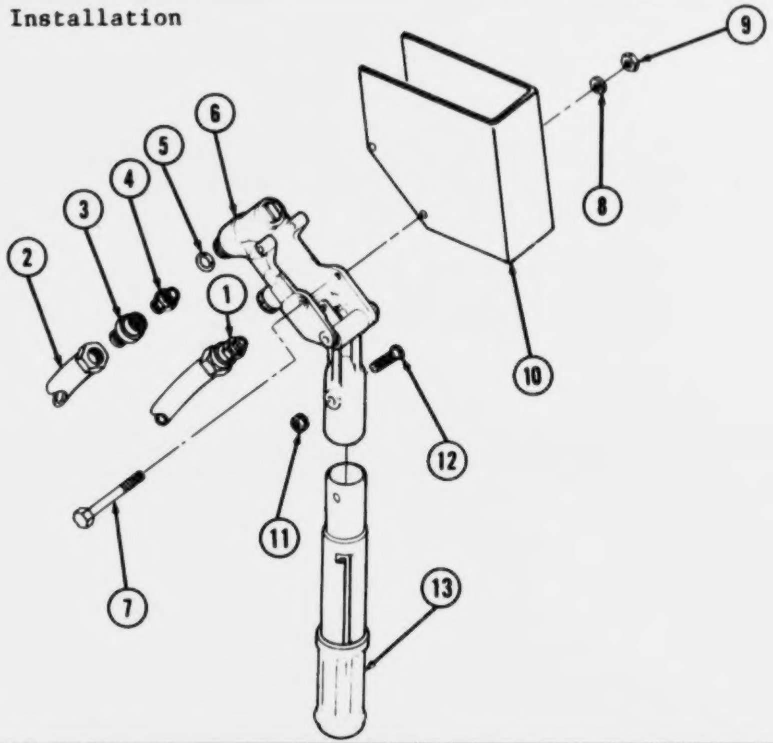
5-11. EQUILIBRATION HANDPUMP ASSEMBLY — Continued

d. Assembly

1 Insert handle assembly (13) into hydraulic pump (6) alining holes for screw (12).

2 Install screw (12) and nut (11) to secure handle assembly (13) to hydraulic pump (6).

e. Installation



1 Install hydraulic pump (6) to mounting bracket (10) with two screws (7), two new lock washers (8) and two nuts (9).

2 Install new preformed packing (5), reducer (4), sleeve (3), nut (2) and adapter (1).

3 Fill, charge, and bleed equilibration system (ref. TM 9-2350-311-20-2).

4 Fill, charge, and bleed cab hydraulic system (ref. TM 9-2350-311-20-2).

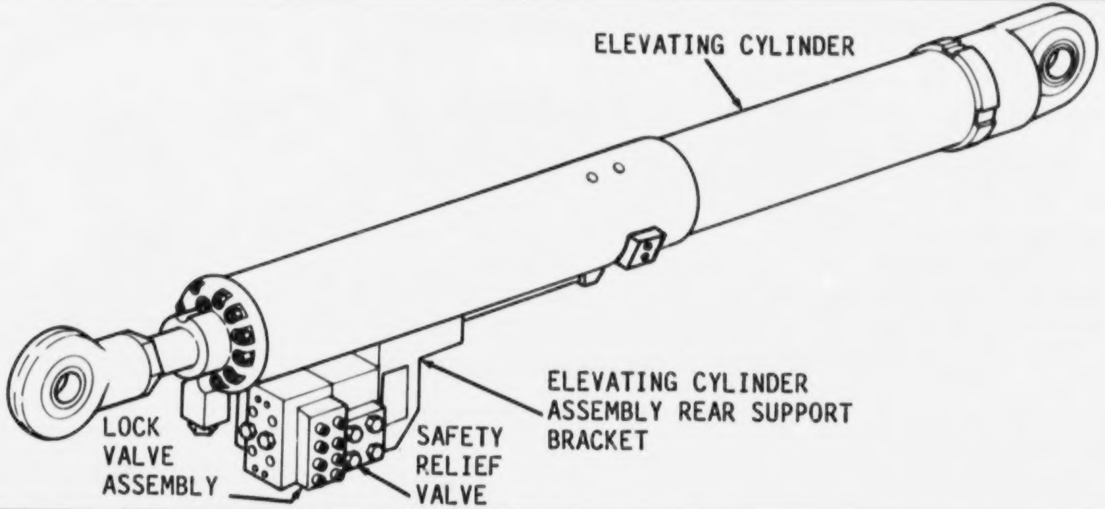
5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR)

This task covers:

a. Drain
b. Removal
c. Disassembly
d. Inspection and Repair
e. Assembly
f. Installation

INITIAL SET-UP

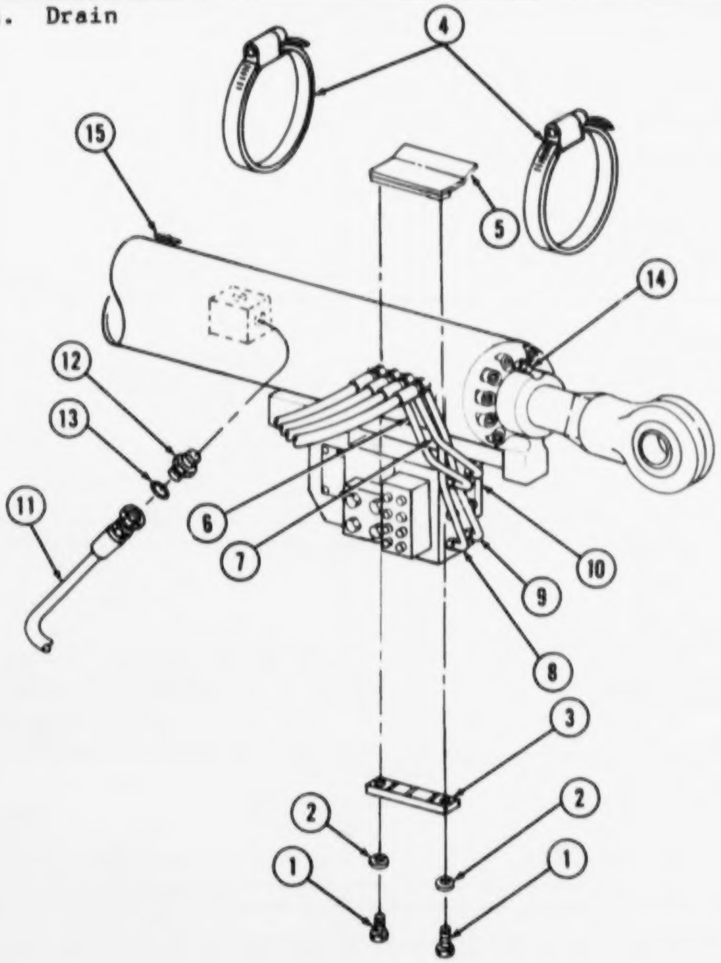
Materials/Parts	Special Tools	Personnel
Repair Parts Kit PN 5911110	Guide tool assembly (App. E)	2
Brass guide rods, 5/16 inch diameter	Spanner wrench (App. E)	
Lock wire	Guide rod (App. E)	
Hydraulic fluid (Item 10, App. C)	Eyebolt	
Sealing compound (Item 19, App. C)	Hoist	
Sealing compound (Item 20, App. C)		
5/16 inch-UNF screws		


ELEVATING CYLINDER
ELEVATING CYLINDER ASSEMBLY REAR SUPPORT BRACKET
LOCK VALVE ASSEMBLY
SAFETY RELIEF VALVE

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

a. Drain



WARNING

Wear safety glasses and steel tipped safety shoes to avoid possible injury while handling equipment.

1 Discharge cab hydraulic system pressure (ref. TM 9-2350-311-20-2).

2 Drain equilibrator hydraulic system and catch hydraulic fluid in a one gallon container (ref. TM 9-2350-311-20-2).

3 Remove two hex head cap screws (1), two flat washers (2) and tube bracket (3).

4 Remove two hose clamps (4) and tube bracket (5).

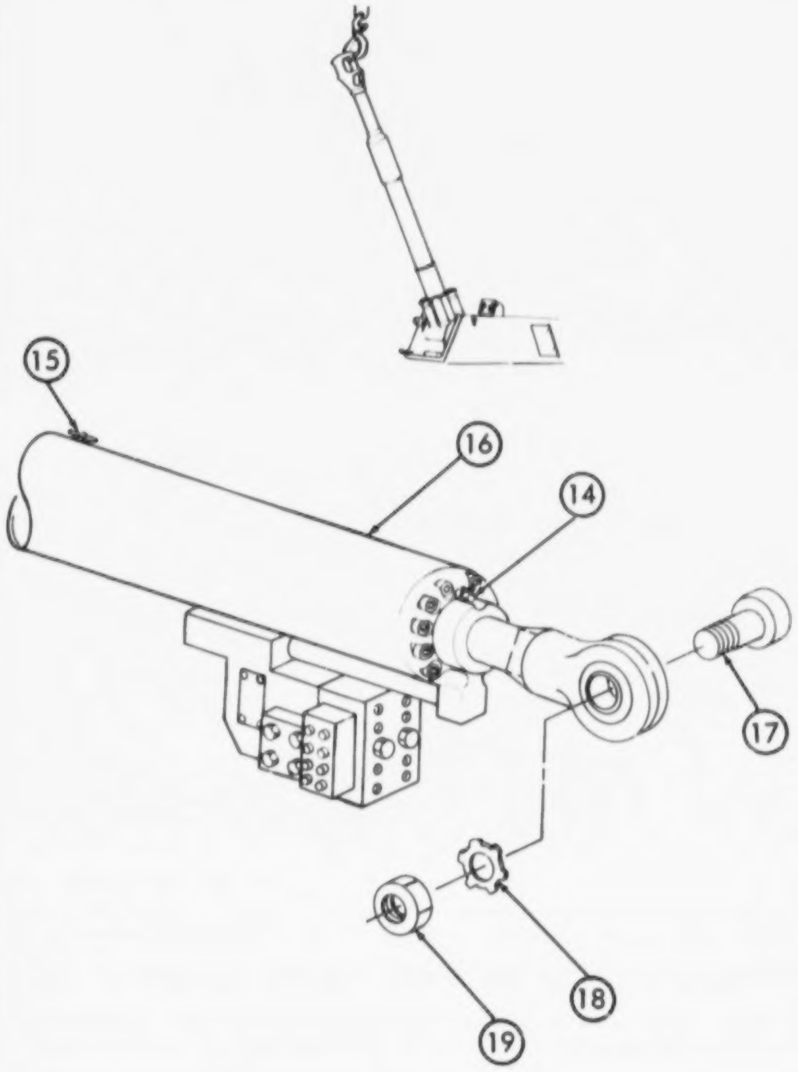
5 Disconnect metallic tubes (6, 7, 8 and 9) at lock valve assembly (10). Catch hydraulic fluid in a five gallon container. Make sure there is adequate clearance between lock valve assembly (10) and the M145 mount.

6 Disconnect hose assembly (11) from nipple (12). Catch hydraulic fluid in a one gallon container.

7 Remove and discard preformed packing (13).

8 Make provision to catch draining hydraulic fluid. Open cylinder bleeder valves (14 and 15).

b. Removal



CAUTION

Failure to open bleed valves could damage elevation piston.

1 Attach strap and hoist to muzzle brake. Raise cannon with hoist. Catch any hydraulic fluid that drips from cylinder bleeder valves (14 and 15).

2 Support elevating cylinder assembly (16) with strap before removing connecting pin (17).

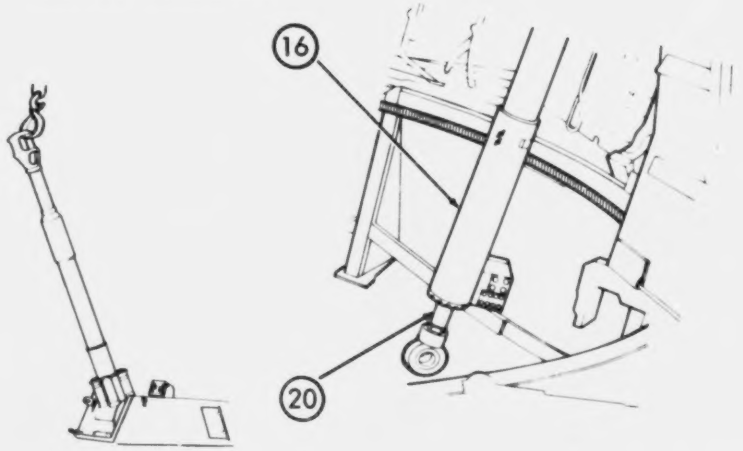
3 Bend back locking tab of key washer (18).

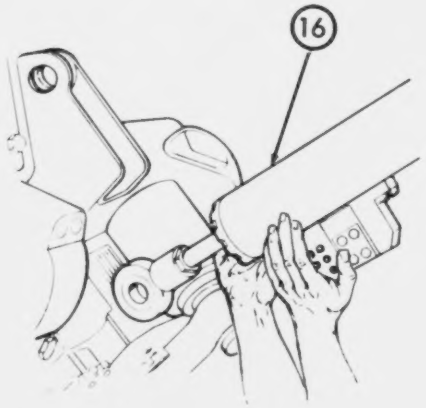
4 Remove plain round nut (19), key washer (18) and connecting pin (17).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

b. Removal-Continued



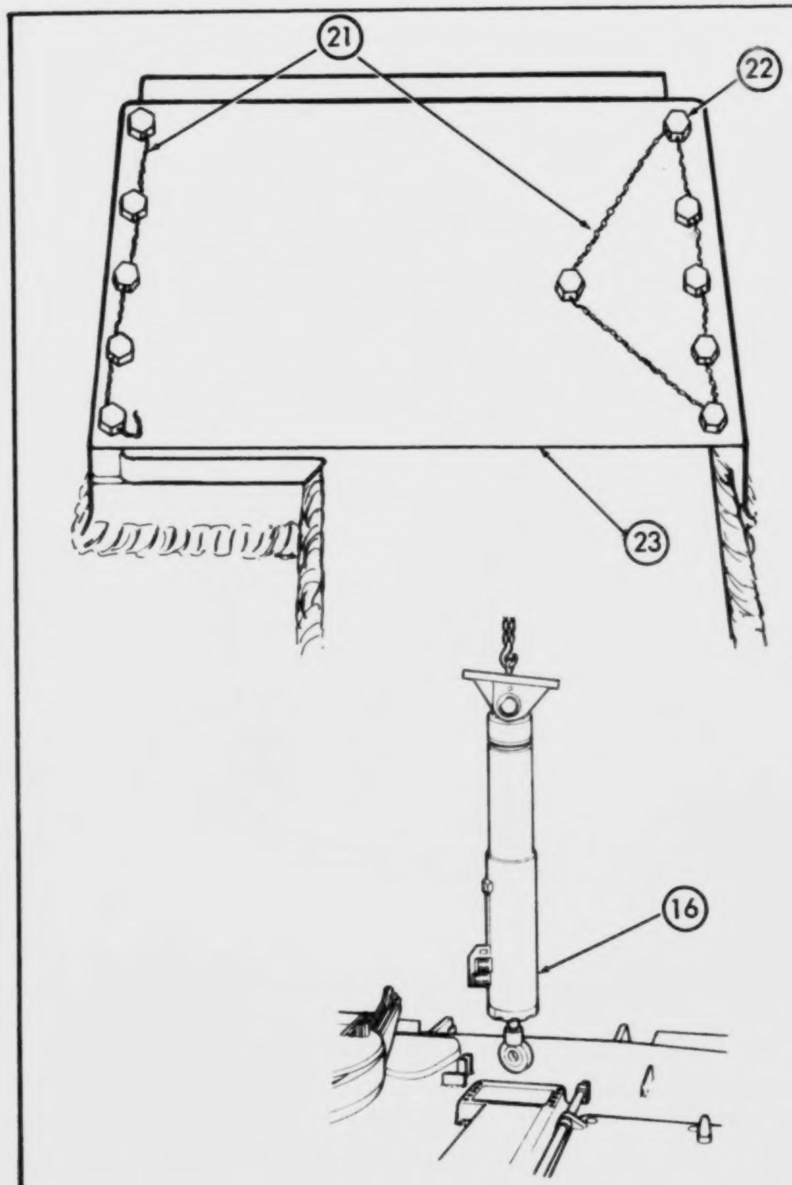


CAUTION

Use care to avoid damage to machined surface of elevating cylinder piston rod.

5 Lower front end of elevating cylinder assembly (16) to vertical position. Protect cylinder piston rod (20) at all times to prevent damage to machined surface.

6 Lower cannon with hoist. Remove strap.



7 Remove and discard lock wire (21).

8 Remove 11 cap screws (22).

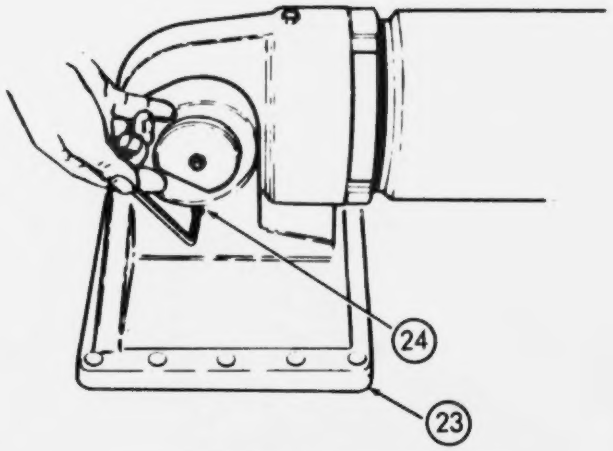
9 Install eyebolt in center screw hole of elevating cylinder assembly rear support bracket (23).

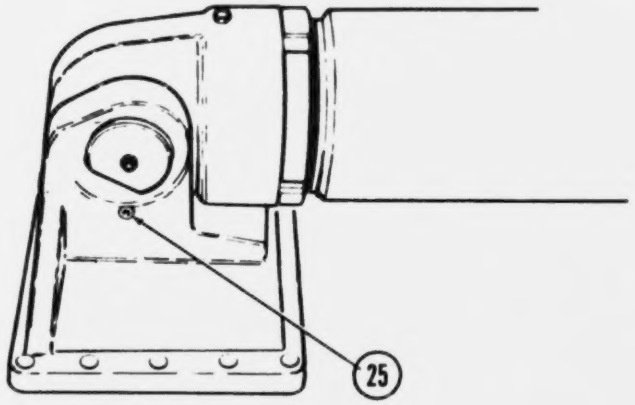
10 Attach hoist to eyebolt. Raise elevating cylinder assembly (16) and elevating cylinder assembly rear support bracket (23) clear of cab. Place elevating cylinder assembly (16) on workbench.

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

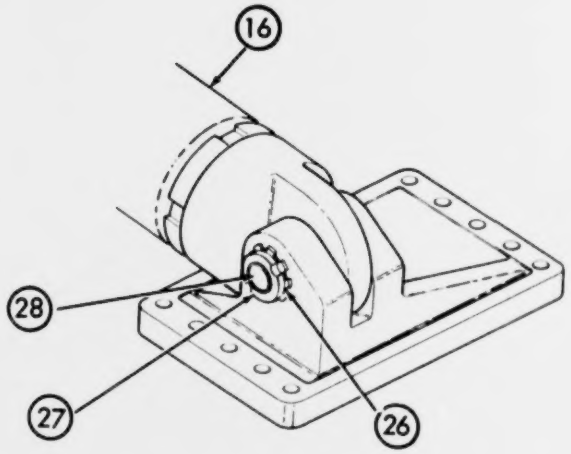
c. Disassembly

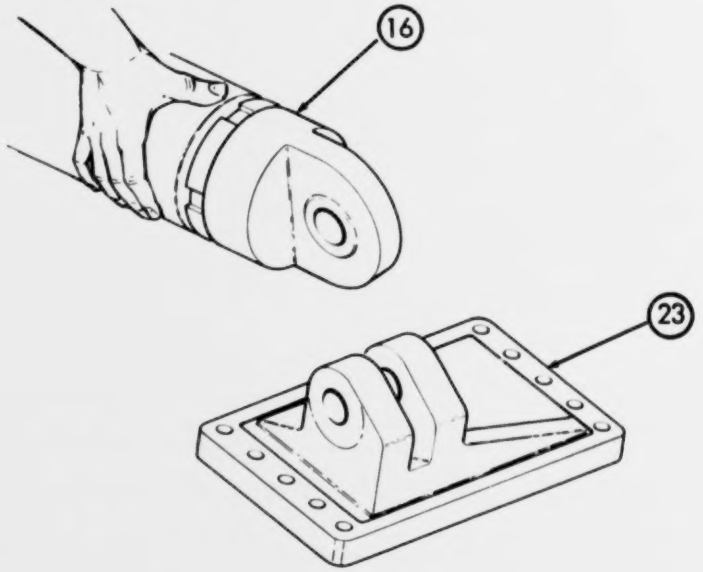




1 Remove locking setscrew (24) at elevating cylinder assembly rear support bracket (23).

2 Remove centering setscrew (25) underneath locking setscrew (24).





3 Bend back locking tab of key washer (26).

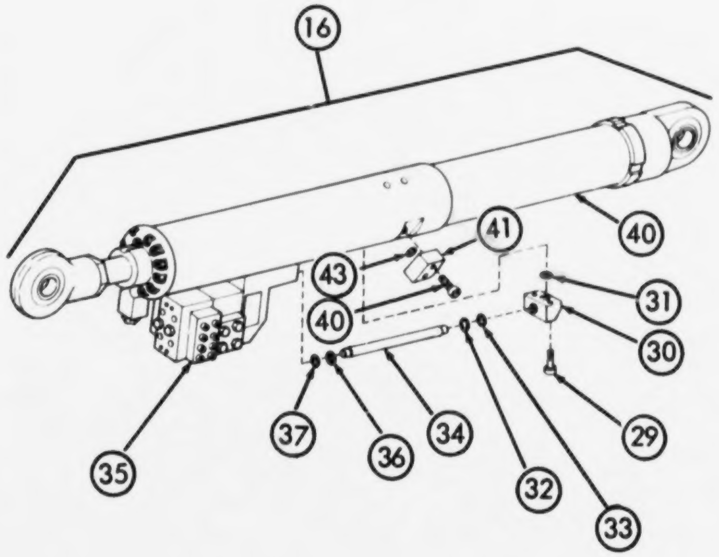
4 Remove nut (27), key washer (26) and pin (28) at rear end of elevating cylinder assembly (16).

5 Separate elevating cylinder assembly (16) from elevating cylinder assembly rear support bracket (23).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

c. Disassembly-Continued



6 Place elevating cylinder assembly (16) on a sturdy workbench and block elevating cylinder assembly (16) for stability.

7 Remove two cap screws (29), block (30) and preformed packing (31). Discard preformed packing (31).

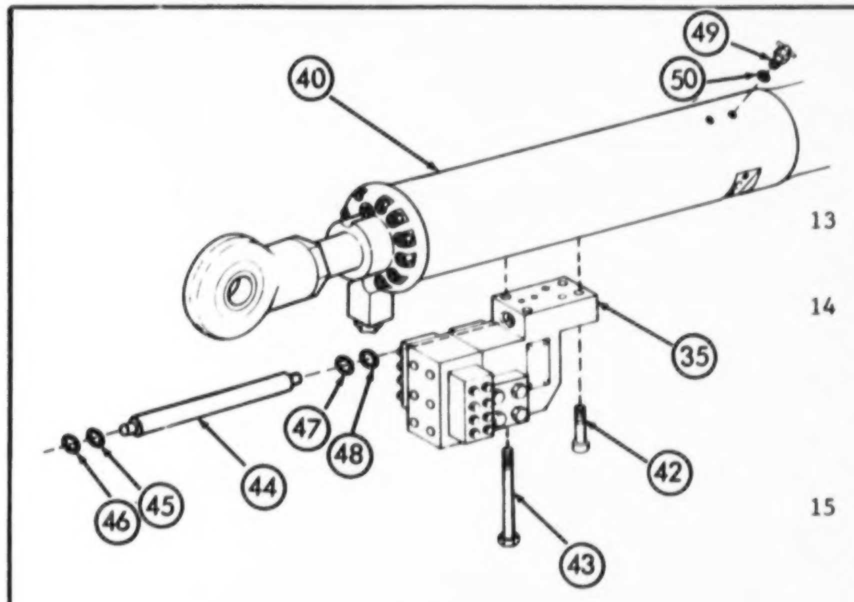
8 Remove and discard packing retainer (32) and preformed packing (33) from block (30).

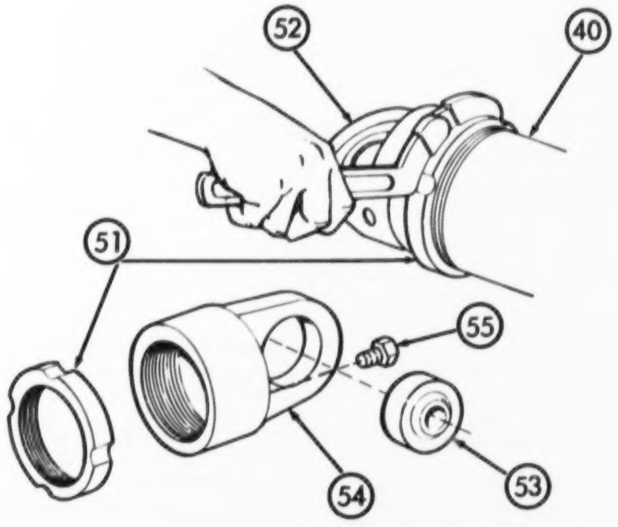
9 Remove tube coupling (34) from elevation valve assemblies (35).

10 Remove and discard packing retainer (36) and preformed packing (37) from elevation valve assemblies (35).

11 Remove two socket head cap screws (38) and manifold block (39) from elevating cylinder (40).

12 Remove and discard preformed packing (41) from manifold block (39).





13 Remove two cap screws (42), two cap screws (43) and elevating cylinder (40).

14 Remove tub coupling (44), packing retainer (45), preformed packing (46), packing retainer (47) and preformed packing (48) from elevation valve assemblies (35). Discard packing retainers (45 and 47) and preformed packings (46 and 48).

15 Remove two bleeder valves (49) and two preformed packings (50) from elevating cylinder (40). Discard preformed packings (50).

16 Loosen nut (51) with spanner wrench.

17 Remove rear eye assembly (52) from elevating cylinder (40).

NOTE

Do not remove bearing assembly unless replacement is required.

18 If required, remove bearing assembly (53) from rear eye (54).

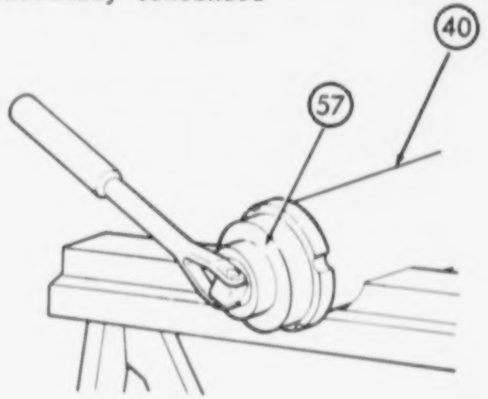
19 Remove breather (55) from rear eye (54).

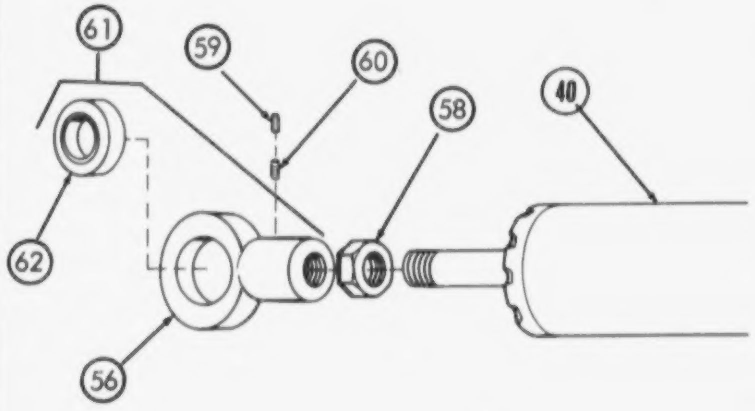
20 Remove nut (51) from elevating cylinder (40).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

c. Disassembly-Continued





21 Restrain elevating cylinder assembly (40) and front eye (56) while adapter (57) is loosened.

CAUTION

Extensive effort is required to loosen adapter which has been torqued to 450 ft-lbs (610 N·m). Avoid side loads to adapter that would damage walls of cylinder.

22 Apply spanner wrench with extension (App. E) to adapter (57) at rear of elevating cylinder (40) and turn counterclockwise. Loosen adapter (57).

23 Restrain front eye (56) while nut (58) is loosened.

24 Loosen nut (58).

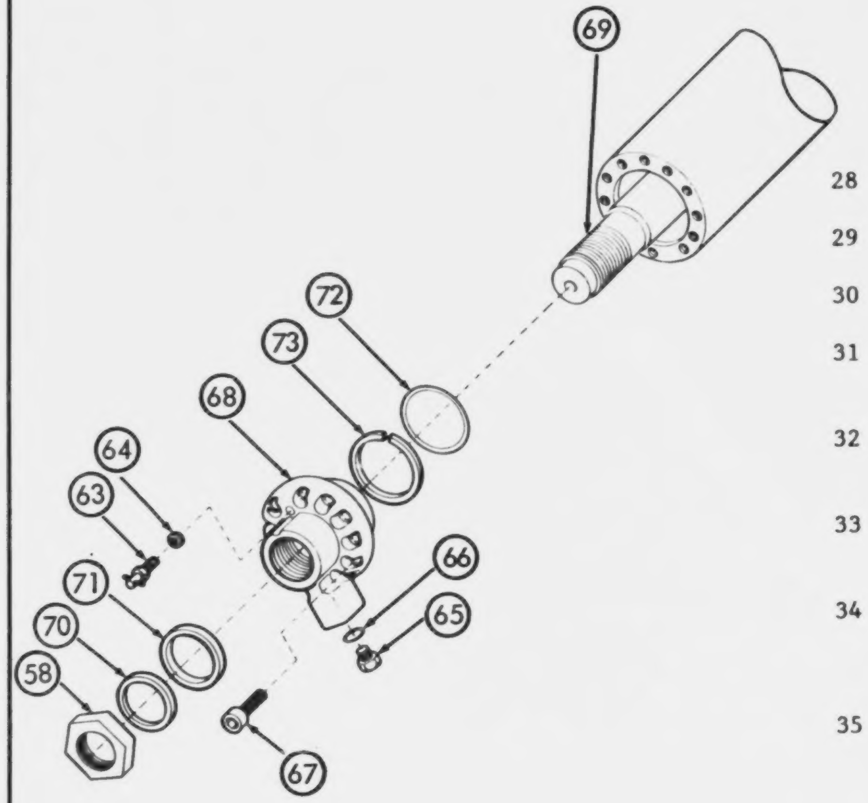
25 Remove locking setscrew (59) and centering setscrew (60) from front eye (56). (Centering setscrew (60) is directly beneath locking setscrew (59).)

26 Remove piston eye assembly (61).

NOTE

Do not remove bearing assembly unless replacement is required.

27 If required, remove bearing assembly (62) from front eye (56).



28 Remove nut (58).

29 Remove bleeder valve (63).

30 Remove and discard preformed packing (64).

31 Remove plug (65) and preformed packing (66). Discard preformed packing (66).

32 Remove 12 socket head cap screws (67) from end cap (68).

33 Remove end cap (68). Provide support for cylinder piston rod (69).

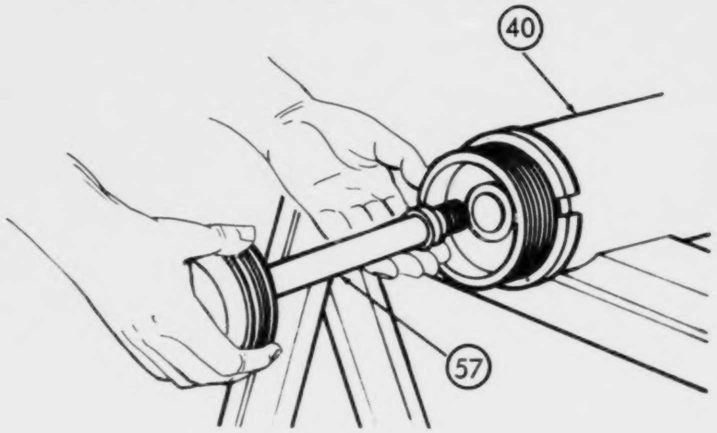
34 Remove and discard ring scraper (70) and seal ring (71). Discard ring scraper (70) and seal ring (71).

35 Remove preformed packing (72) and split ring (73) from rear of end cap (68). Discard preformed packing (72).

CAB HYDRAULICS — Continued

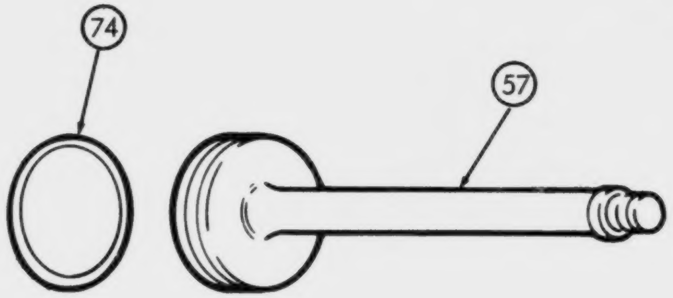
5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) – Continued

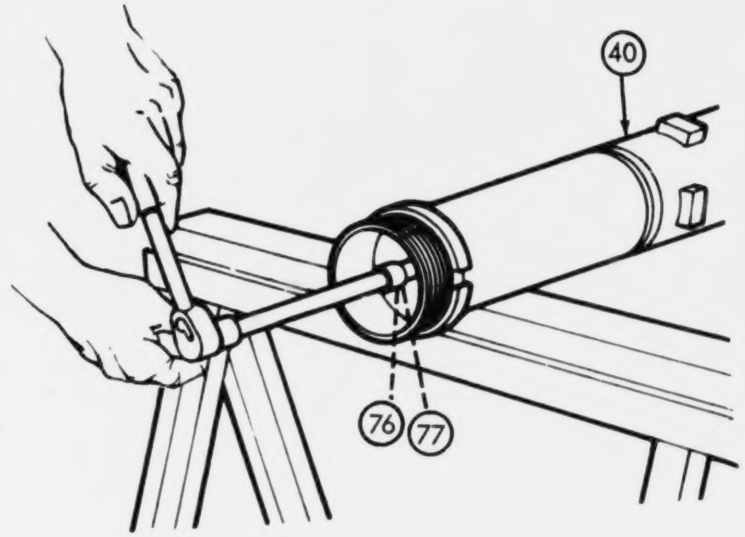
c. Disassembly-Continued



36 Unscrew adapter (57). Remove adapter (57) from rear of elevating cylinder (40) by hand, being careful not to scratch smooth, finished inner bore of elevating cylinder (40).

37 Remove and discard seal (74) from adapter (57).

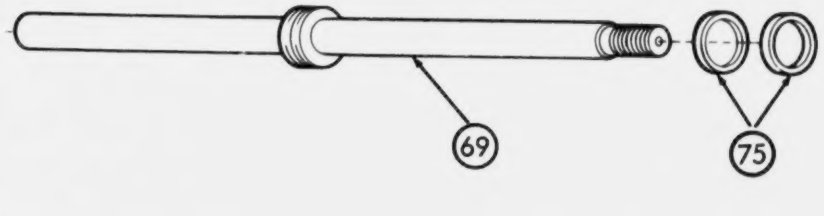




38 Restrain elevating cylinder (40) and withdraw cylinder piston rod (69) from front end of elevating cylinder (40), being careful not to scratch the smooth, finished inner bore of the elevating cylinder (40).

39 Remove and discard two groove seal rings (75) from cylinder piston rod (69).

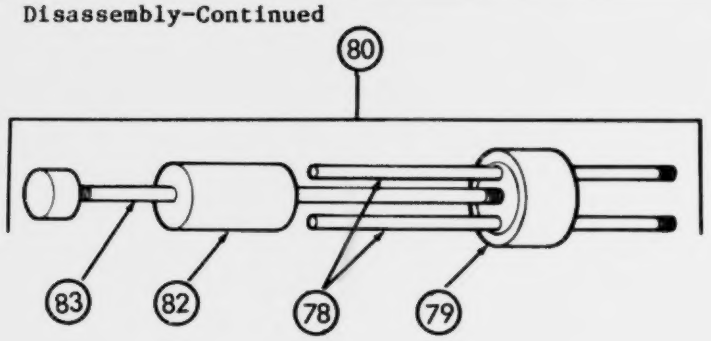
40 Restrain elevating cylinder (40). Remove two cap screws (76) from rear bearing half (77) with socket wrench and extension.

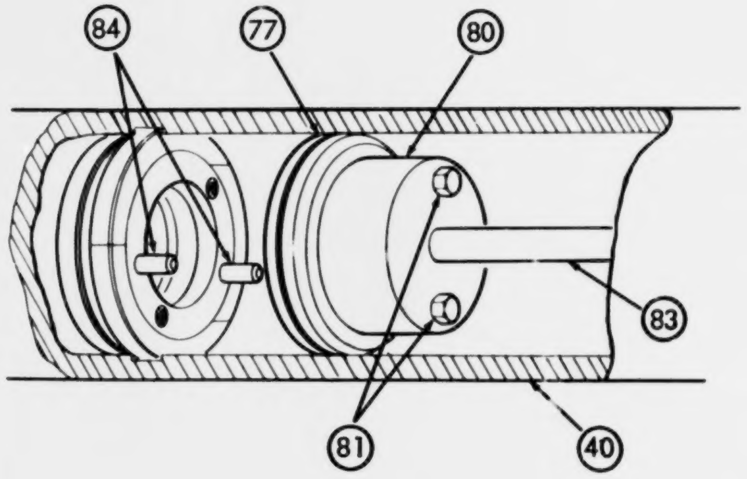


CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

c. Disassembly-Continued



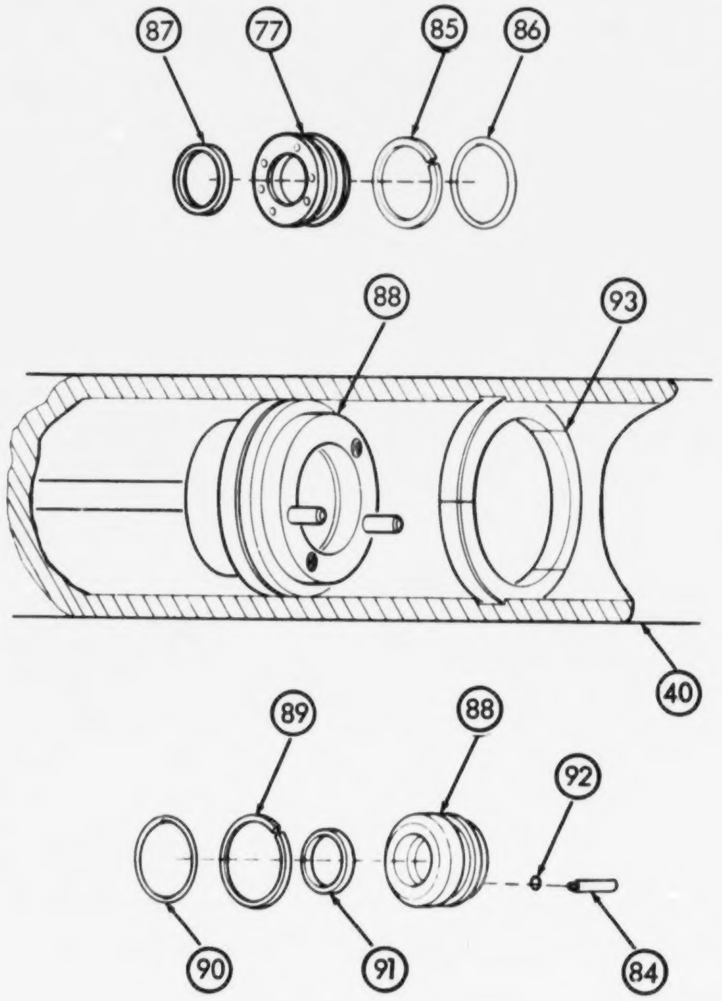


41 Place two 5/16-inch diameter brass guide rods (78) thru bearing guide (79). Screw two brass guide rods (78) into rear bearing half (77).

42 Slide guide tool assembly (80) (App. E) into elevating cylinder (40) on two 5/16-inch diameter brass guide rods (78) until cylinder on front of bearing guide (79) fits into bearing center.

43 Replace two 5/16-inch diameter brass guide rods (78) one at a time with two 5/16 inch-24 UNF screws (81). Use socket wrench and extension (ref. page 5-127) to install two 5/16 inch-24 UNF screws (81).

44 Remove rear bearing half (77) from elevating cylinder (40) by tapping slide (82) back against handle (83) to separate from two pins (84).



45 Remove split ring (85), preformed packing (86) and seal ring (87) from rear bearing half (77). Discard split ring (85), preformed packing (86) and seal ring (87).

46 Remove front bearing half (88) from front of elevating cylinder (40) as in steps 41 thru 43.

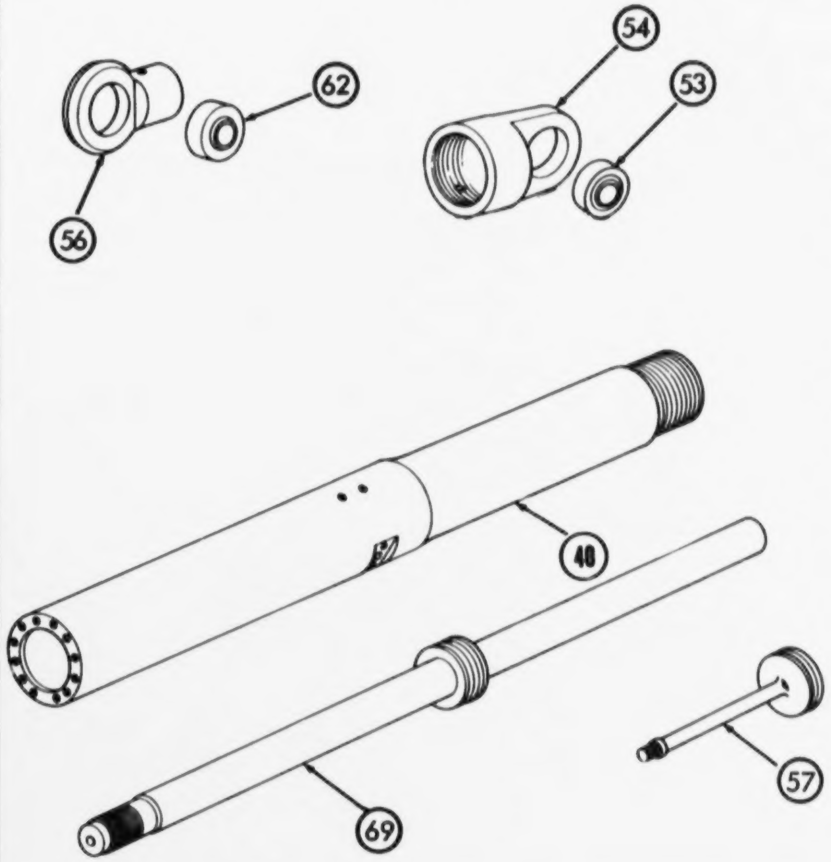
47 Remove split ring (89), preformed packing (90), seal ring (91) and four preformed packings (92) from front bearing half (88). Remove two pins (84). Discard split ring (89), preformed packing (90), seal ring (91), and four preformed packings (92).

48 Remove three key segments (93) from elevating cylinder (40).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

d. Inspection and Repair



1 Inspect bearing assemblies (53) and 62) (ref. TM 9-214 for proper cleaning, inspection and lubrication procedures).

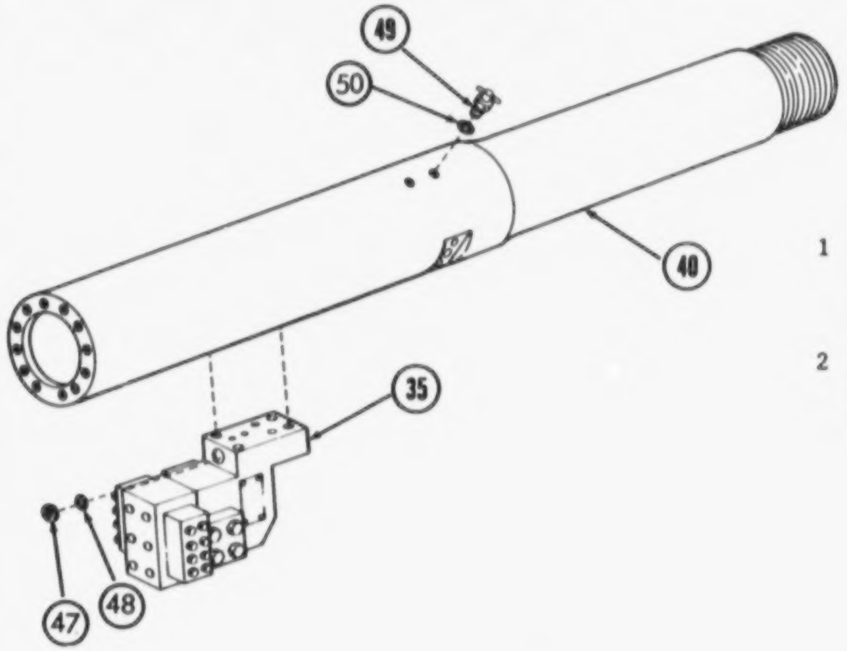
2 Inspect front eye (56) and rear eye (54). Replace if cracked or distorted. If threads have nicks, burrs or other damage, repair threads and use again.

3 Inspect adapter (57). Replace if scored or scratched.

4 Inspect cylinder piston rod (69). Replace if scored or scratched.

5 Inspect elevating cylinder (40). Replace if cracked, distorted or bore is scored or scratched.

e. Assembly



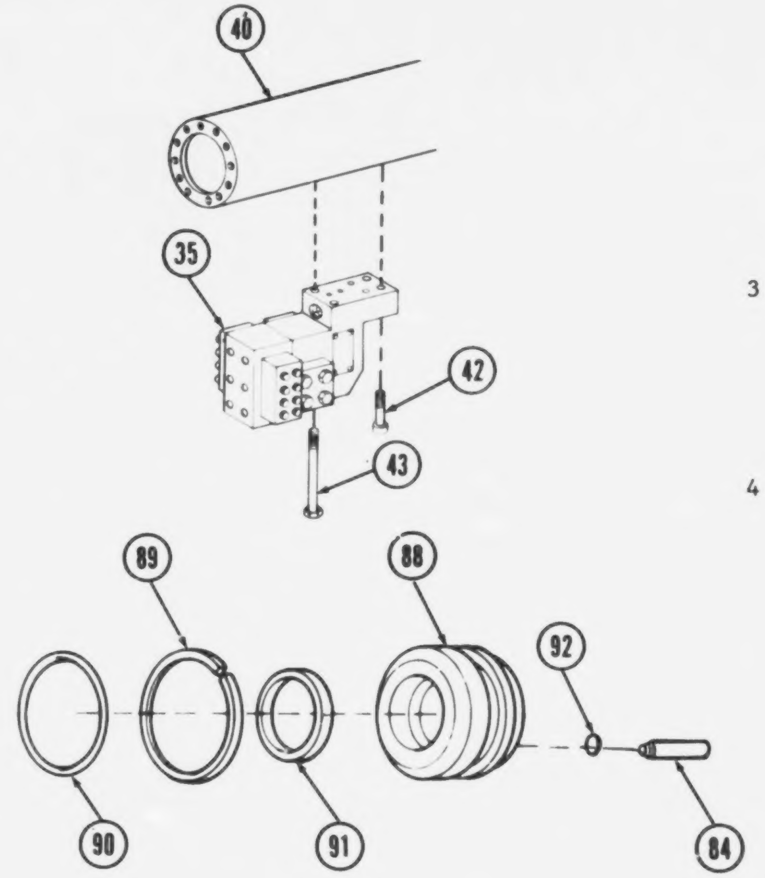
1 Install two new preformed packings (50) and two bleeder valves (49) in elevating cylinder (40).

2 Install new preformed packing (48) and new packing retainer (47) in elevation valve assemblies (35).

CAB HYDRAULICS — Continued

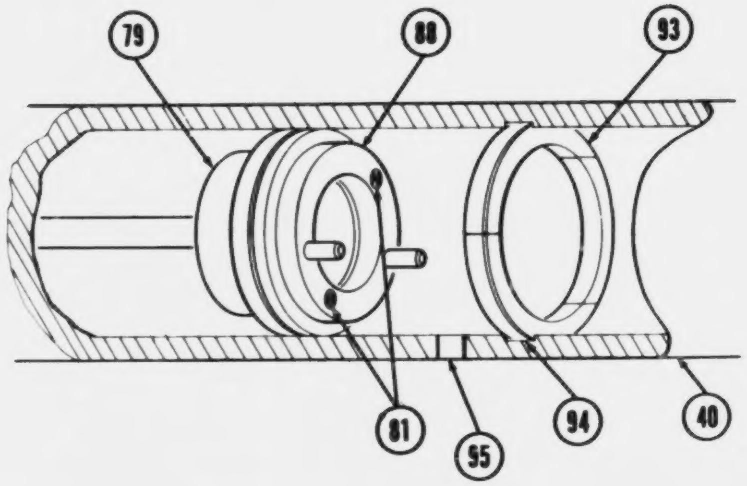
5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

e. Assembly-Continued



3 Apply sealing compound (Item 19, App. C) to two cap screws (42) and two cap screws (43). Install elevation valve assemblies (35) to elevating cylinder (40) with two cap screws (42) and two cap screws (43). Torque cap screws (42) and (43) to 20 lb-ft (27 N.m).

4 Lubricate two pins (84), new seal ring (91), new preformed packing (90), new split ring (89) and four new preformed packings (92) with hydraulic fluid (Item 10, App. C). Install on front bearing half (88). Be sure all packings and seals are secure.



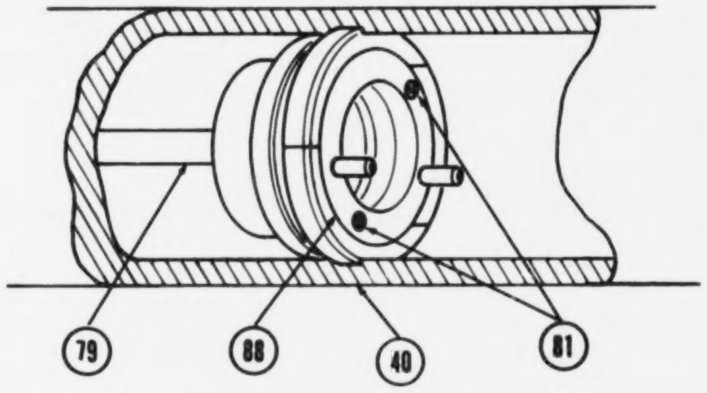
5 Fasten two 5/16 inch-24 UNF screws (81) and bearing guide (79) to front bearing half (88).

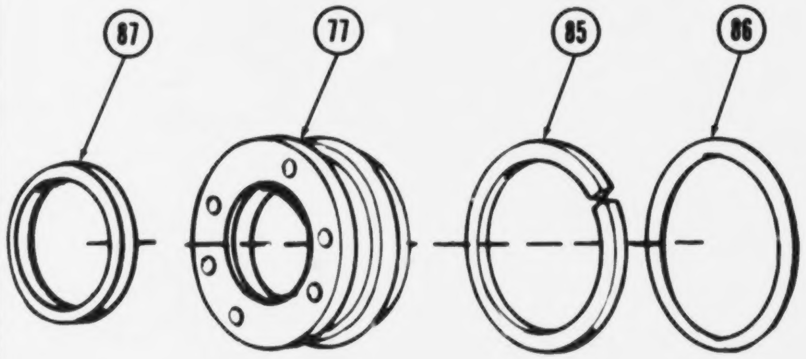
6 Slide bearing guide (79) into elevating cylinder (40) from the front end. Have a second technician place and hold three key segments (93) in center groove (94) while front bearing half (88) is pushed into place. Be careful that new preformed packing (90) on front bearing half is not cut or damaged as it passes over oil port (95). Observe new preformed packing (90) through oil port (95).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

e. Assembly-Continued





7 Remove two 5/16 inch-24 UNF screws (81) from bearing guide (79) with socket wrench and extension (ref. page 5-127).

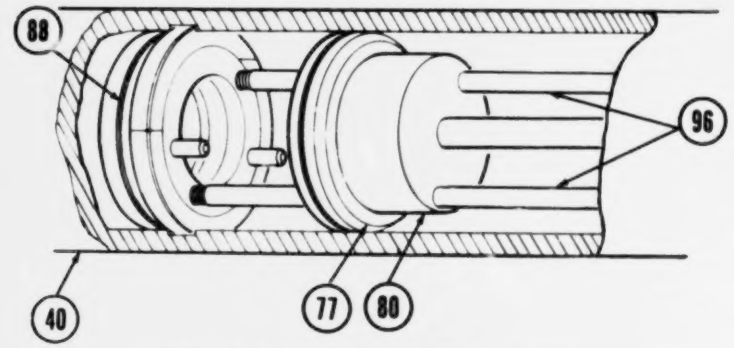
8 Withdraw bearing guide (79) from elevating cylinder (40).

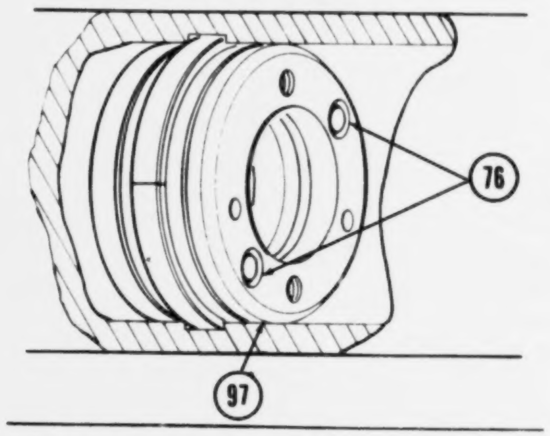
9 Lubricate new seal ring (87), new preformed packing (86) and new split ring (85) with hydraulic fluid (Item 10, App.C). Install on rear bearing half (77).

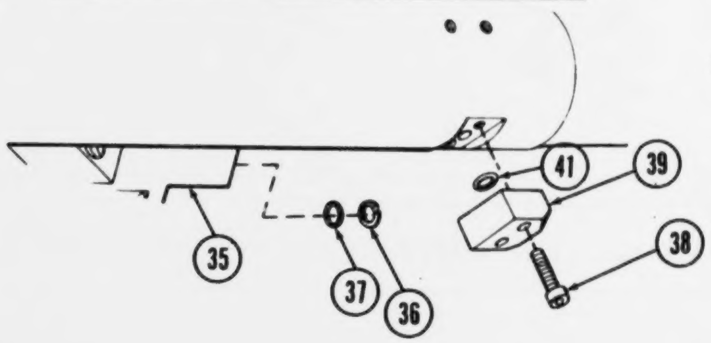
10 Place rear bearing half (77) on front cylinder of bearing guide (79).

11 Insert two 1/4 inch-28 UNF guide rods (96) through bearing guide (79) and rear bearing half (77) into rear of elevating cylinder (40). Screw two 1/4 inch-28 UNF guide rods (96) into mating holes of front bearing half (88). This insures proper alinement of pins and cap screw holes in front bearing half (88) and rear bearing half (77).

12 Slide rear bearing half (77) into elevating cylinder (40).







13 Remove guide tool assembly (80) (App. E) by unscrewing two 1/4 inch-28 UNF guide rods (96).

14 Apply sealing compound (Item 19, App. C) to two cap screws (76). Install two cap screws (76) into bearing assembly (97) using socket wrench and extension (ref. page 5-127). Torque two cap screws (76) to 9 lb-ft (12 N·m).

15 Install new preformed packing (41) in manifold block (39).

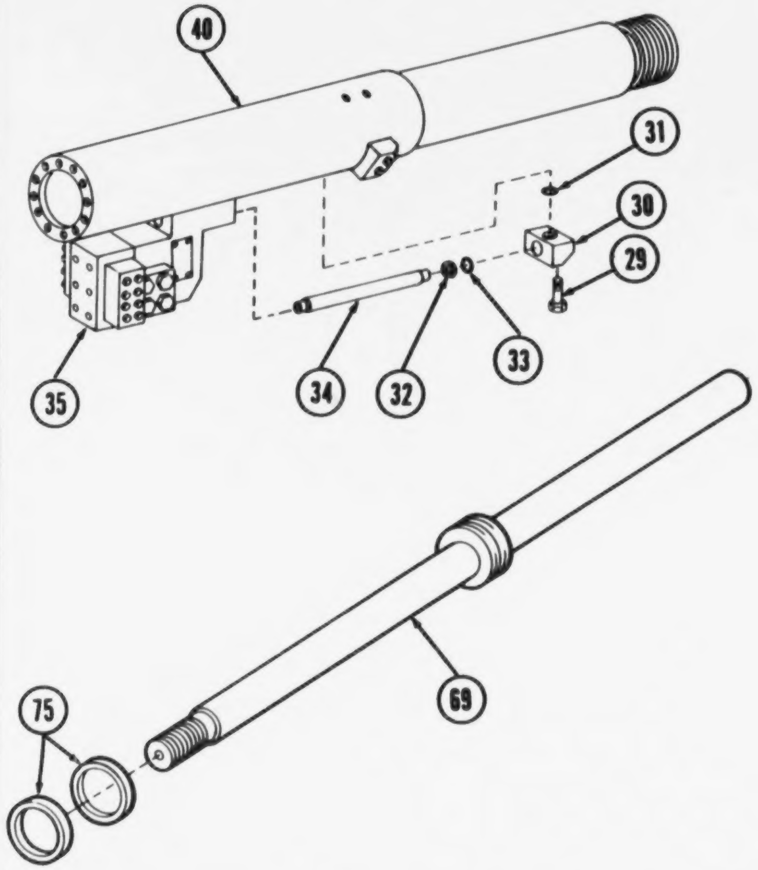
16 Apply sealing compound (Item 19, App. C) to two socket head cap screws (38). Install manifold block (39) to elevating cylinder (40) with two socket head cap screws (38). Torque socket head cap screws (38) to 20 lb-ft (27 N·m).

17 Install new preformed packing (37) and new packing retainer (36) in elevation valve assemblies (35).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

e. Assembly-Continued



18 Install tube coupling (34) to elevation valve assemblies (35).

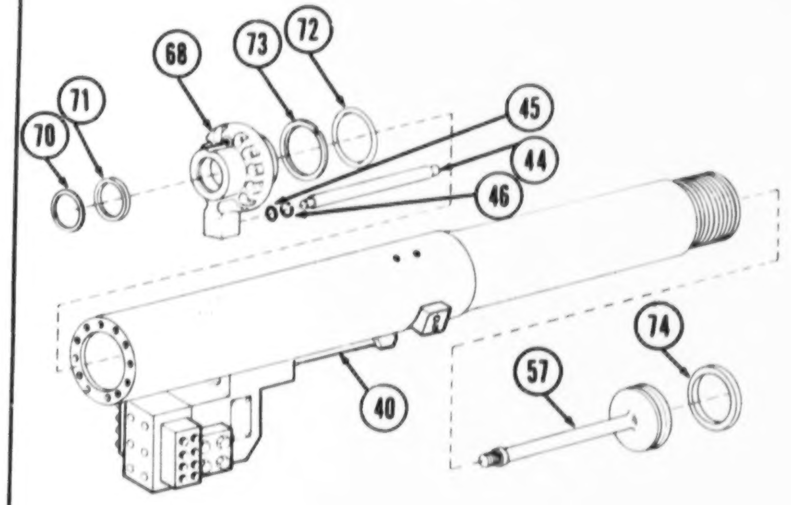
19 Install two new preformed packings (31) and (33) and new packing retainer (32) in block (30).

20 Connect block (30) to tube coupling (34).

21 Apply sealing compound (Item 19, App. C) to threads of two cap screws (29). Install block (30) to elevating cylinder (40) with two cap screws (29). Torque cap screws (29) to 20 lb-ft (27 N·m).

22 Lubricate two new groove seal rings (75) with hydraulic fluid (Item 10, App. C). Install on cylinder piston rod (69).

23 Restrain elevating cylinder (40) and install cylinder piston rod (69) into elevating cylinder (40) thru front end, being careful not to scratch smooth finished inner bore of elevating cylinder (40) or to damage two new groove seal rings (75).



24 Lubricate new groove seal ring (74) with hydraulic fluid (Item 10, App. C). Install on adapter (57).

25 Install adapter (57) by screwing it into rear of elevating cylinder (40) by hand. Be careful not to scratch inner bore of elevating cylinder (40).

26 Lubricate new preformed packing (72), new split ring (73), new seal ring (71) and new ring scraper (70) with hydraulic fluid (Item 10, App. C). Install on end cap (68).

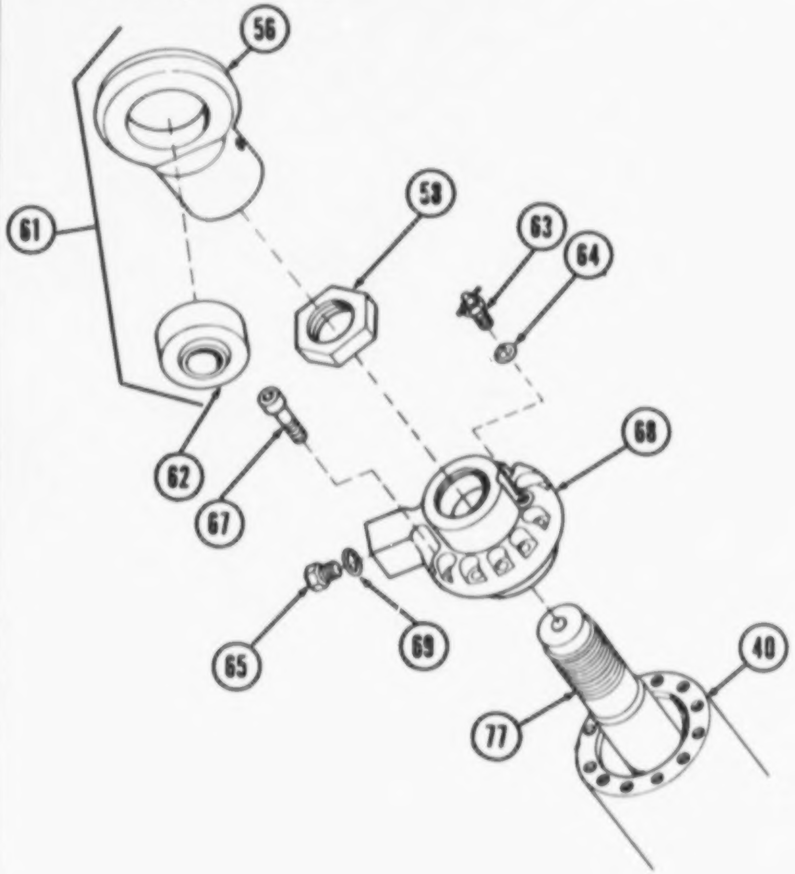
27 Lubricate new preformed packing (46) and new packing retainer (45) with hydraulic fluid (Item 10, App. C). Install in end cap (68).

28 Install tube coupling (44) to end cap (68).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

e. Assembly-Continued



29 Place end cap (68) on cylinder piston rod (69).

30 Apply sealing compound (Item 19, App. C) to threads of 12 socket head cap screws (67). Install 12 socket head cap screws (67), securing end cap (68) to elevating cylinder (40). Torque 12 socket head cap screws (67) to 90 lb-ft (122 N·m).

31 Install new preformed packing (64) and bleeder valve (63) on end cap (68).

32 Install new preformed packing (66) and plug (65).

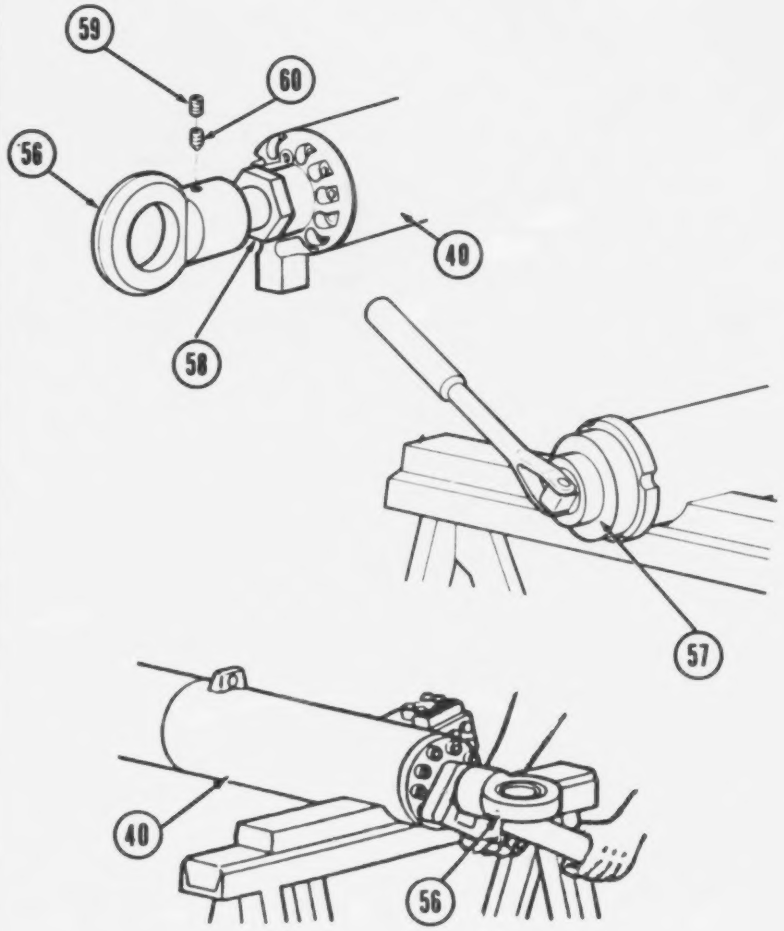
NOTE

Apply sealing compound (Item 19, App. C) to threads of nut. Eye assembly must bottom out on shoulder of piston rod before installing locking setscrew.

33 Install nut (58) on cylinder piston rod (69).

34 Install bearing assembly (62) in front eye (56) and stake in place.

35 Install piston eye assembly (61) on cylinder piston rod (69) and clinch tight with nut (58).



36 Apply sealing compound (Item 19, App. C) to threads of locking setscrew (59) and centering setscrew (60). Install locking setscrew (59) and centering setscrew (60) in front eye (56) and torque to 6 lb-ft (8 N·m).

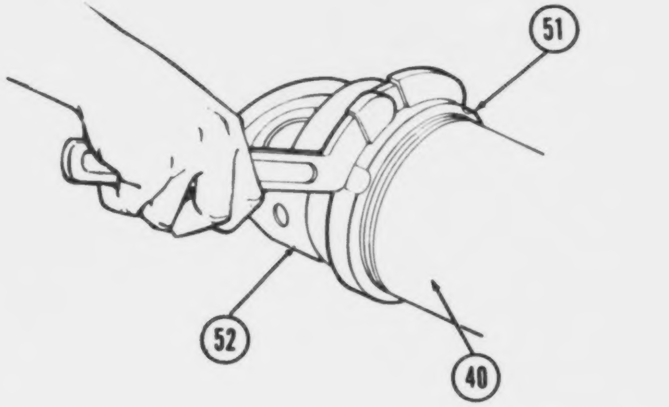
37 Restrain front eye (56) and torque nut (58) to 200 lb-ft (271 N.m).

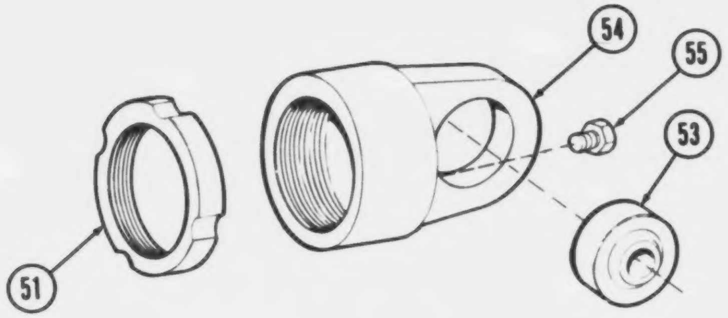
38 Restrain front eye (56). Apply sealing compound (Item 19, App. C) to adapter (57). Using spanner wrench with extension (App. C), alternately torque to 450 ±50 lb-ft (610 ±68 N·m) and loosen adapter (57) three times before final torquing to 450 lb-ft (610 N·m). After final torquing be sure there is a minimum of 0.001 inch (0.002 mm) between adapter (57) and inner bore of elevating cylinder (40).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

e. Assembly-Continued





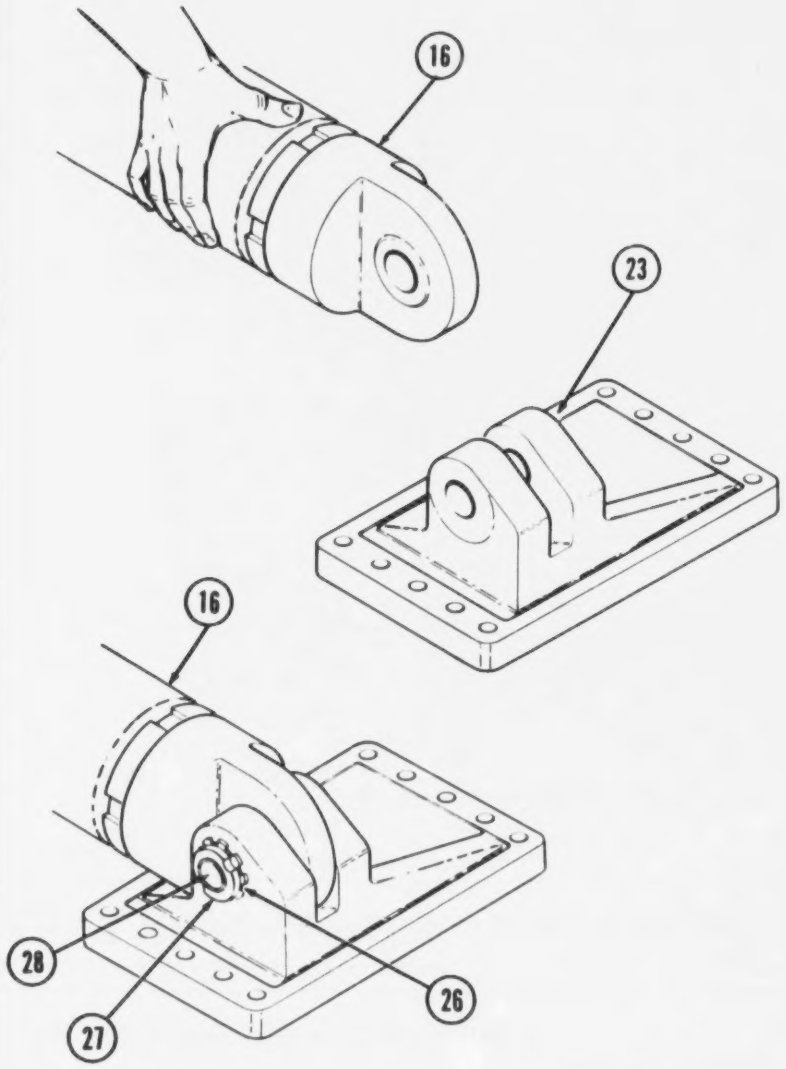
39 Install nut (51) on elevating cylinder (40).

40 Install breather (55) on rear eye (54).

41 Install bearing assembly (53) in rear eye (54) and stake bearing assembly (53) in place.

42 Install rear eye assembly (52) on elevating cylinder (40) until it bottoms on elevating cylinder (40), then back rear eye assembly (52) off as necessary so that rear eye (54) is in line with elevation valve assemblies (35) (ref. page 5-135).

43 Tighten nut (51) with spanner wrench against rear eye assembly (52) after rear eye assembly (52) is alined.



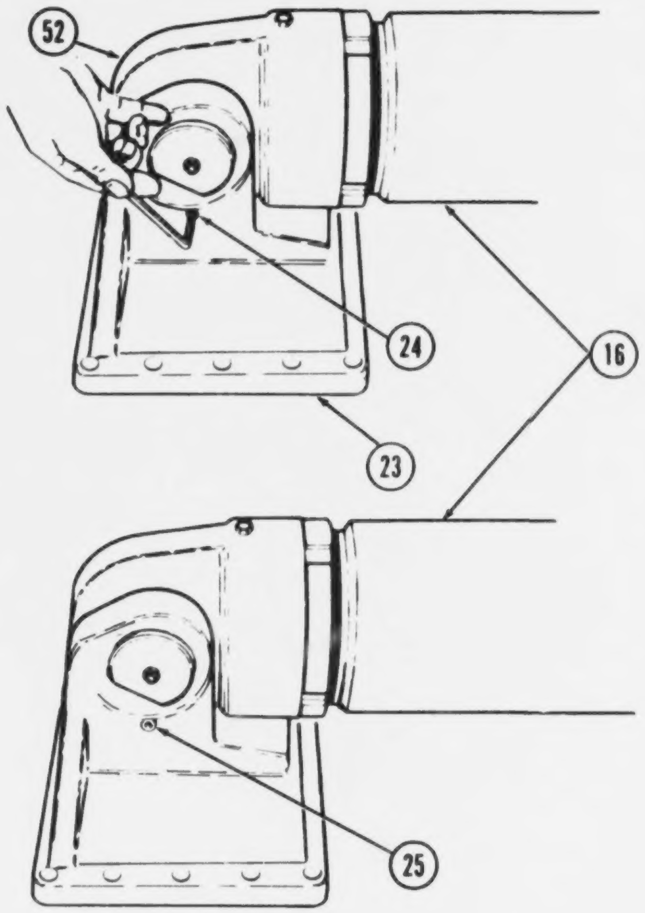
44 Place rear eye of elevating cylinder assembly (16) in support bracket (23).

45 Install pin (28), key washer (26) and nut (27). Bend locking tab of key washer (26) to secure nut (27).

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) – Continued

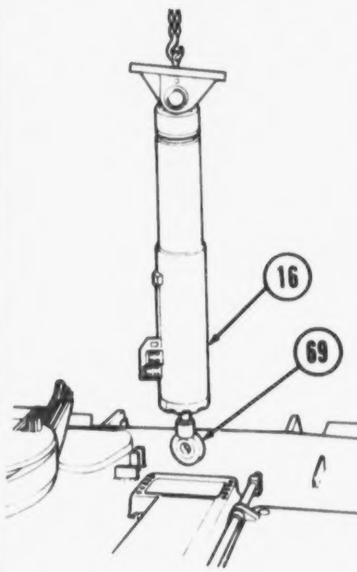
e. Assembly-Continued

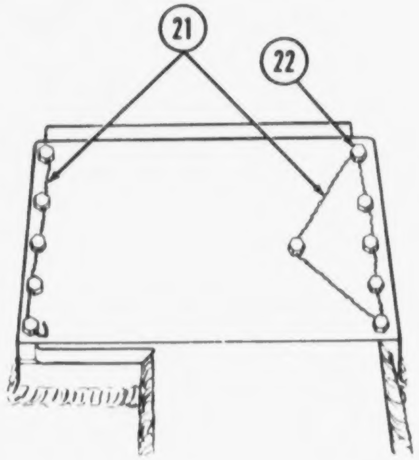


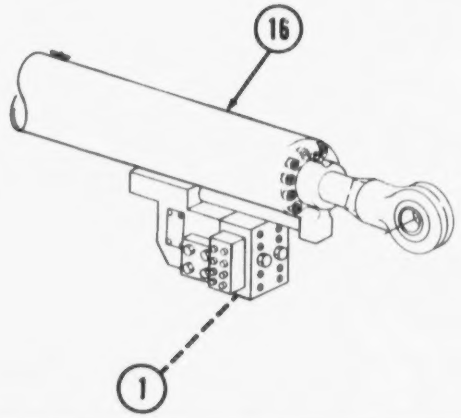
46 Apply sealing compound (Item 19, App. C) to threads of centering setscrew (25). Turn centering setscrew (25) until equal clearance is obtained between rear eye assembly (52) and elevating cylinder assembly rear support bracket (23) on each side of rear eye assembly (52).

47 Apply sealing compound (Item 19, App. C) to threads of locking setscrew (24). Install in elevating cylinder assembly rear support bracket (23) directly over centering setscrew (25).

f. Installation







1 Inspect area of cab roof to which elevating cylinder assembly rear support bracket (23) will be attached. Look for cracks and damaged threads in holes for mounting hex head cap screws (1). Repair defects as required before installing elevating cylinder assembly (16).

2 Install eyebolt into center screw hole of elevating cylinder assembly rear support bracket (23).

3 Attach hoist to eyebolt. Raise elevating cylinder assembly (16) and elevating cylinder rear support bracket (23) to position over cab roof. Lower through hole in cab roof.

4 Position support bracket in place on inside cab roof and secure by installing 11 cap screws (22).

5 Secure 11 cap screws (22) with new lock wire (21).

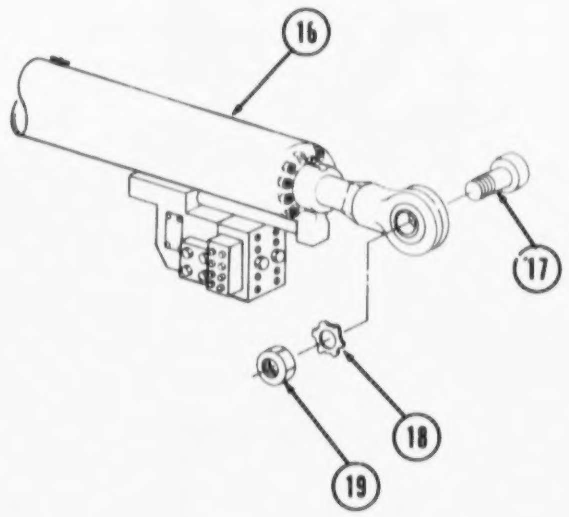
6 Install strap (ref. page 5-117) to muzzle brake of cannon and raise cannon with hoist.

7 Being careful to protect machined surface of cylinder piston rod (69) from scratches and damage, raise front end of elevating cylinder assembly (16) toward mount inside cab.

CAB HYDRAULICS — Continued

5-12. ELEVATING MECHANISM ASSEMBLY (EQUILIBRATOR) — Continued

f. Installation-Continued



8 Install connecting pin (17), key washer (18) and plain round nut (19). Bend up tab on key washer (18) to secure plain round nut (19).

CAUTION

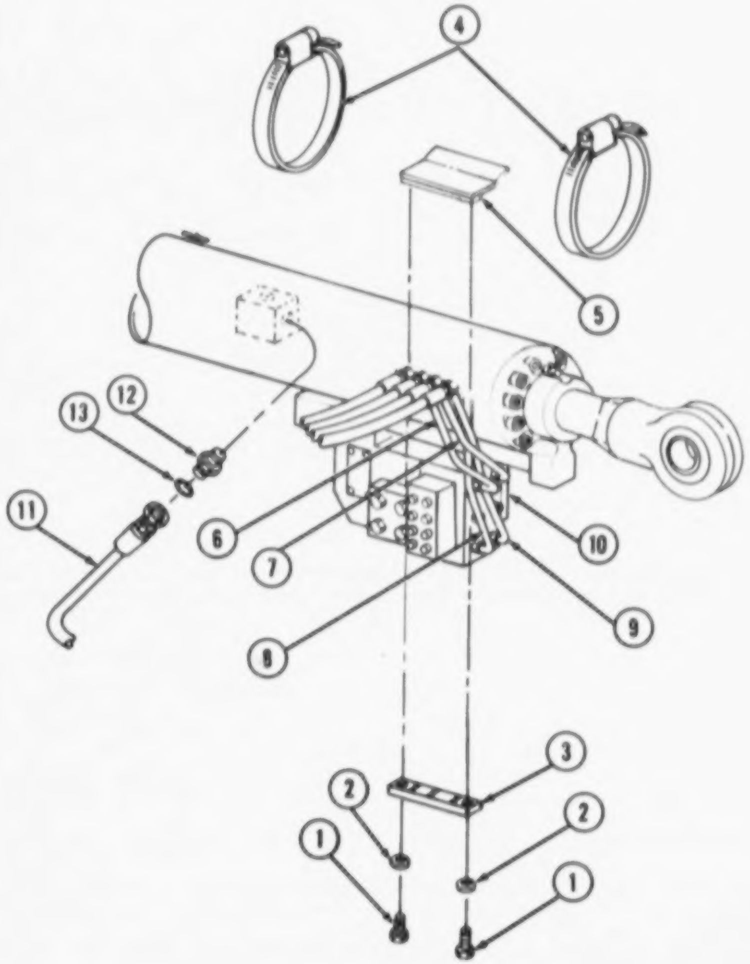
Failure to open bleed valves could damage elevation piston.

9 Lower cannon with hoist.

10 Install new preformed packing (13).

11 Connect hose assembly (11) to nipple (12).

12 Connect metallic tubes (6, 7, 8 and 9) to locking valve assembly (10).



13 Position tube bracket (5) on elevating cylinder assembly (18) alining it with metallic tubes (6 thru 9) and secure tube bracket (5) with two hose clamps (4).

14 Install tube bracket (3) to tube bracket (5) with two flat washers (2) and two hex head cap screws (1).

15 Fill, charge and bleed equilibrator hydraulic system (ref. TM 9-2350-311-20-2).

16 Fill, charge and bleed cab hydraulic system (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

5-13. ELEVATION VALVE ASSEMBLIES (SAFETY RELIEF AND LOCK)

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts

Preformed packings
Lock washers

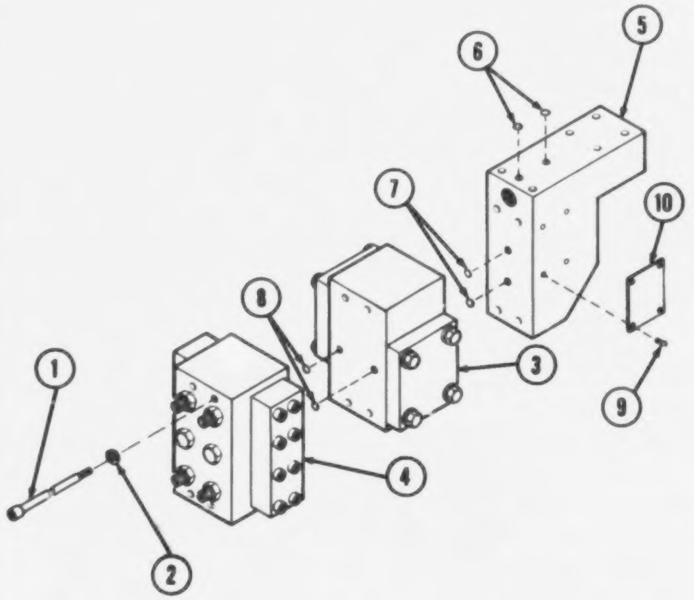
WARNING

Wear safety glasses and steel tipped shoes to avoid possible injury while handling equipment.

NOTE

Howitzer may use one of three different lock valve assemblies, part numbers 8744652, 11783942 and 11784023, identifiable by number stamped in body. Lock valve assemblies PN 8744652 and 1178342 are replaced by lock valve assembly P/N 11784023. If any of these valves are unserviceable, do not repair. Replace with new lock valve assembly.

a. Disassembly



1 Remove elevation valve assemblies, lock valve assembly and bracket assembly (as an assembly) (ref. page 5-134).

2 Remove four socket head cap screws (1) and four lock washers (2) from elevation valve assemblies. Separate safety relief valve (3), lock valve assembly (4) and bracket (5).

3 Remove two preformed packings (6) from top of bracket (5) and discard.

4 Remove two preformed packings (7) from face of bracket (5) and discard.

5 Remove two preformed packings (8) from face of safety relief valve (3) and discard.

NOTE

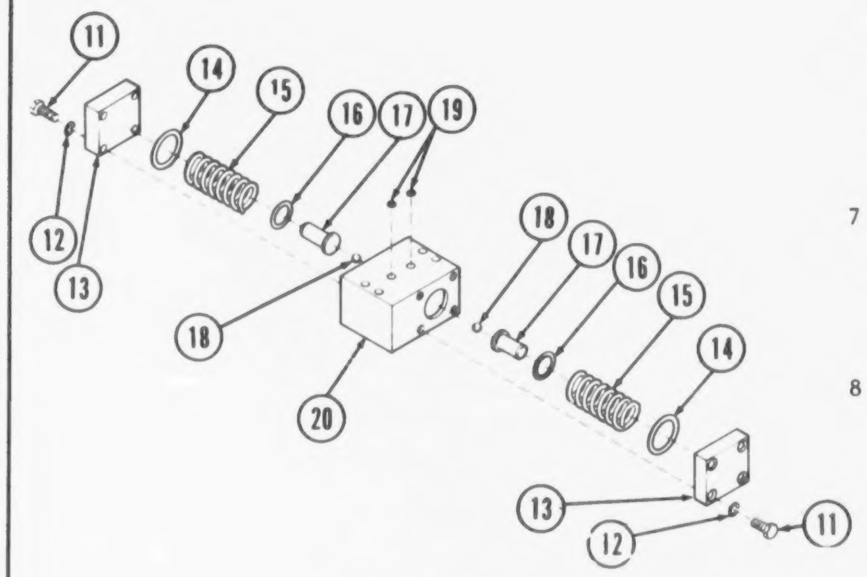
Do not remove drive screws (9) and name plate (10) unless it is damaged and requires replacement.

6 Remove four drive screws (9) and nameplate (10) from bracket (5).

CAB HYDRAULICS — Continued

5-13. ELEVATION VALVE ASSEMBLIES (SAFETY RELIEF AND LOCK) – Continued

a. Disassembly-Continued



WARNING

Access covers hold springs under compression. Restrain access covers to avoid injury.

7 Loosen eight cap screws (11) gradually until all spring compression is relieved. Remove eight cap screws (11), eight lock washers (12) and two access covers (13). Discard washers (12).

8 Remove two springs (15), two preformed packings (14), shims (16) (if present), two guides (17), two balls (18) and two preformed packings (19) from valve body (20). Discard four preformed packings (14 and 19). Retain shims (16) for use in assembly.

b. Inspection

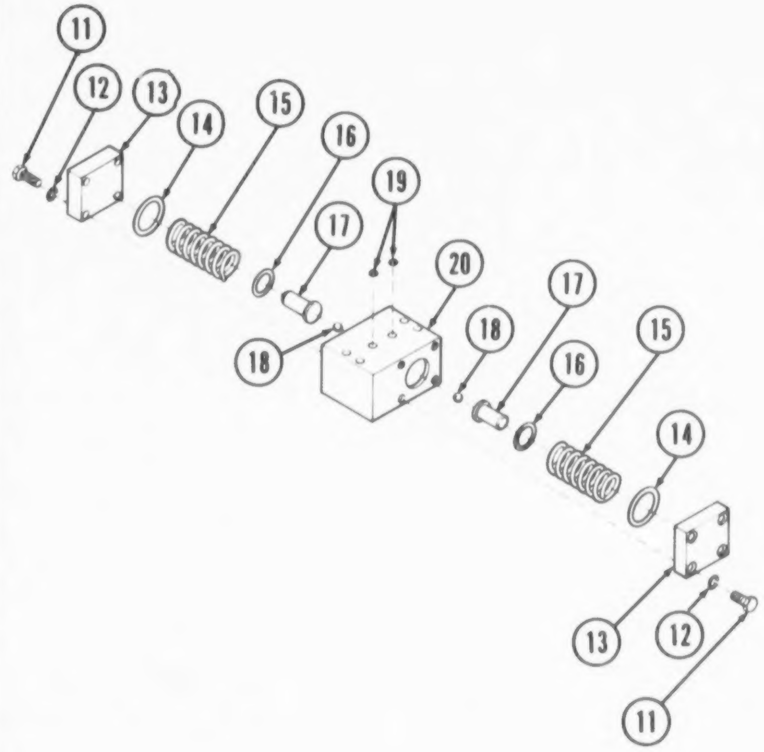
1 Inspect all parts. Replace any that are damaged, distorted, scratched on machined surfaces, or have damaged threads.

2 Inspect ball seat in valve body (20). If damaged, replace complete safety relief valve assembly (ref. page 5-147).

CAB HYDRAULICS — Continued

5-13. ELEVATION VALVE ASSEMBLIES (SAFETY RELIEF AND LOCK) – Continued

c. Assembly

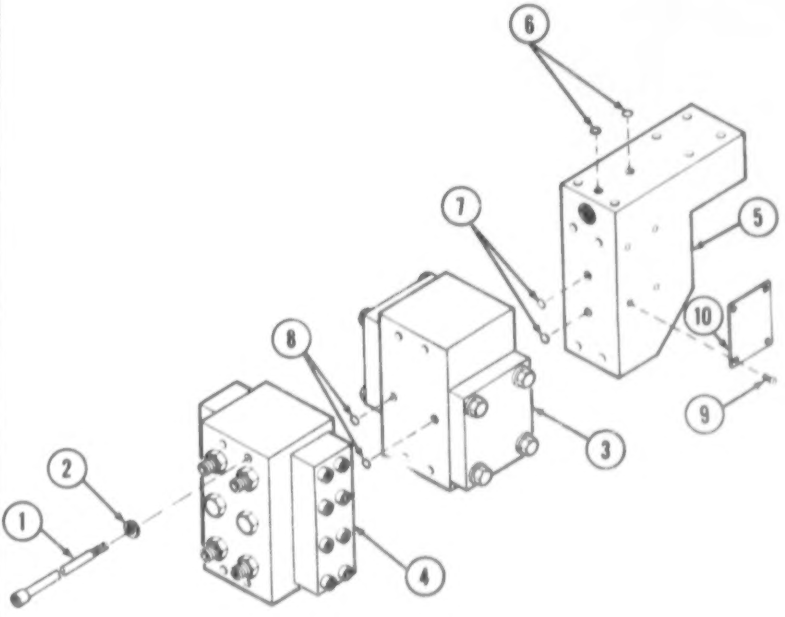


1 Install two new preformed packings (19), two balls (18), two guides (17), shims (16) (if present), two new preformed packings (14) and two springs (15) in valve body (20).

WARNING

Access covers must hold springs under high compression load. Restrain access covers while assembling to avoid injury.

2 Install two access covers (13), eight new lock washers (12) and eight cap screws (11). Tighten eight cap screws (11) gradually until springs (15) are fully compressed.



3 Install nameplate (10) and four drive screws (9) on bracket (5).

4 Install two new preformed packings (8) on face of safety relief valve (3).

5 Install two new preformed packings (7) on face of bracket (5).

6 Install two new preformed packings (6) on top of bracket (5).

7 Assemble bracket (5), lock valve assembly (4) and safety relief valve (3). Position lock valve assembly (4) so that plugs are at the bottom when attaching to safety relief valve (3) and bracket (5).

8 Install four lock washers (2) and four socket head cap screws (1) to secure components of elevation valve assemblies.

9 Install elevation valve assemblies (ref. page 5-131).

CAB HYDRAULICS — Continued

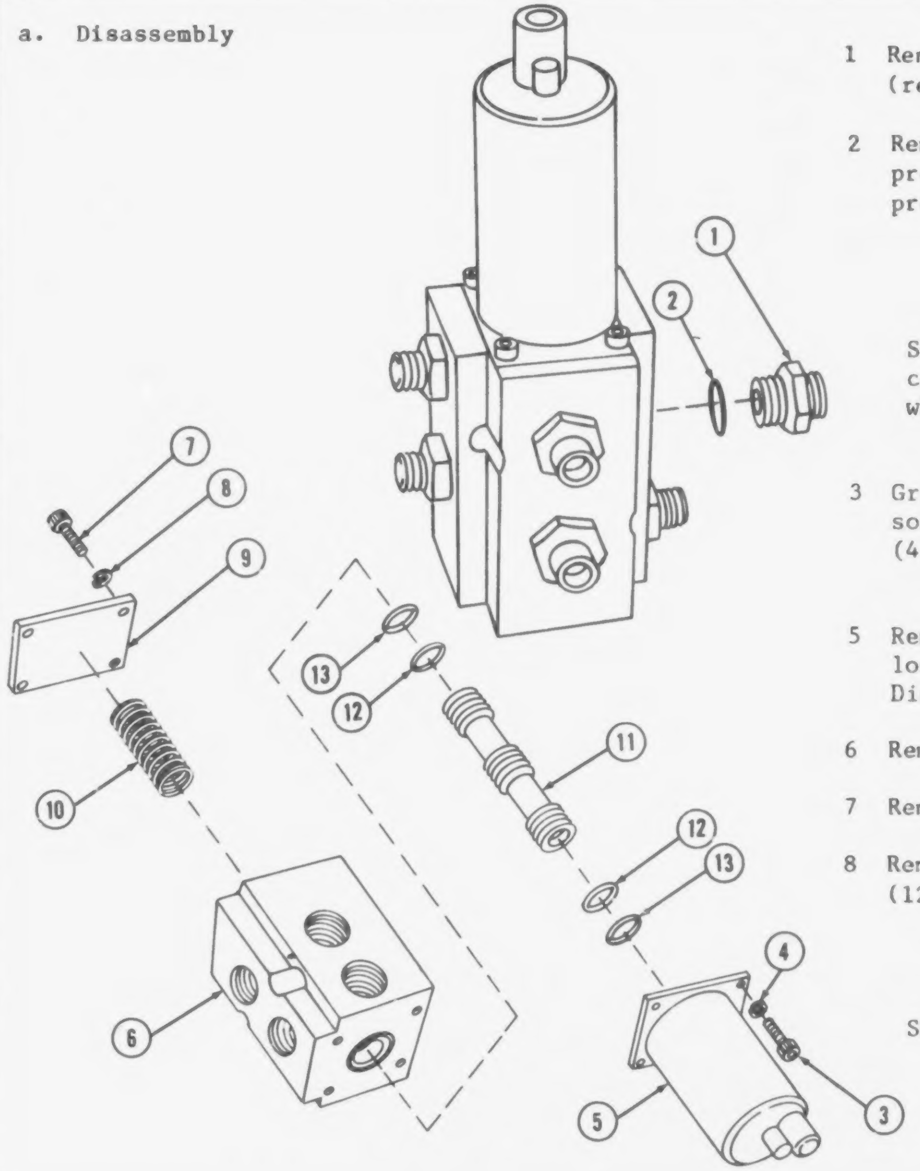
5-14. ELEVATION SELECTOR VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts
Preformed packings
Hydraulic fluid (Item 10, App. C)
Multimeter

a. Disassembly



1 Remove elevation selector valve assembly (ref. TM 9-2350-311-20-2).

2 Remove six straight reducers (1) and six preformed packings (2). Discard six preformed packings (2).

WARNING

Solenoid must hold springs under high compression load. Restrain solenoid while disassembling to avoid injury.

3 Gradually and evenly unscrew and remove four socket head cap screws (3) and lock washers (4). Discard four lock washers (4).

5 Remove four socket head cap screws (7), four lock washers (8) and valve body plate (9). Discard four lock washers (8).

6 Remove spring (10).

7 Remove valve spool (11).

8 Remove and discard two preformed packings (12) and two rings (13).

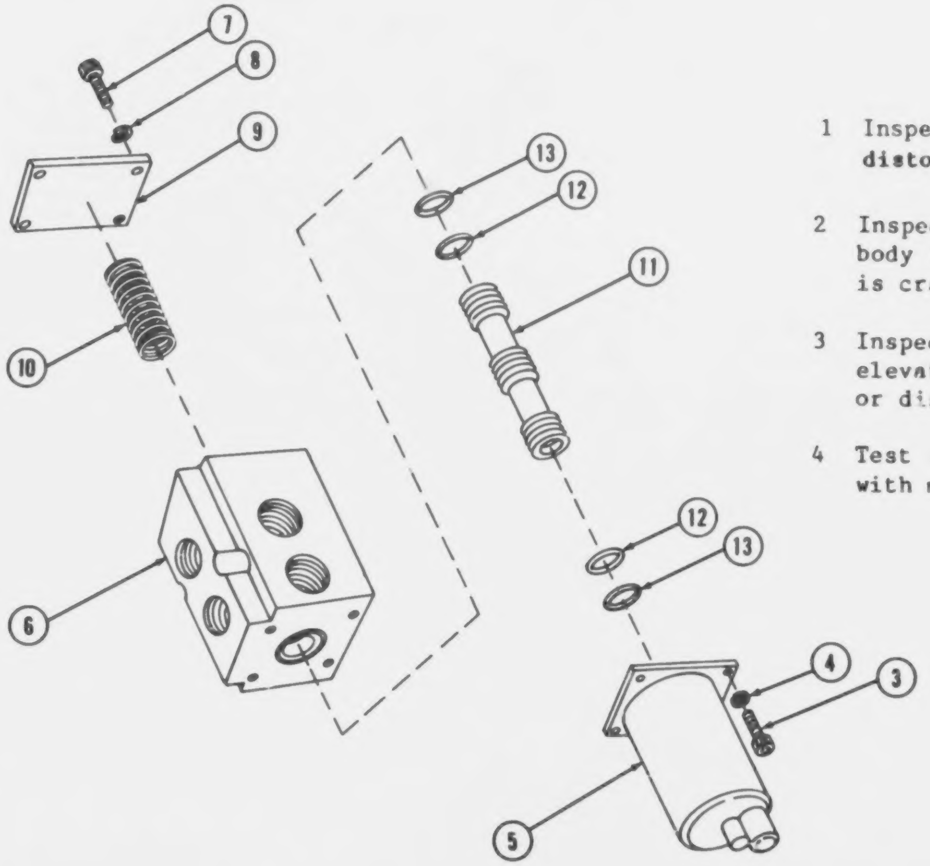
NOTE

Some valves may not have rings (3).

CAB HYDRAULICS — Continued

5-14. ELEVATION SELECTOR VALVE ASSEMBLY – Continued

b. Inspection



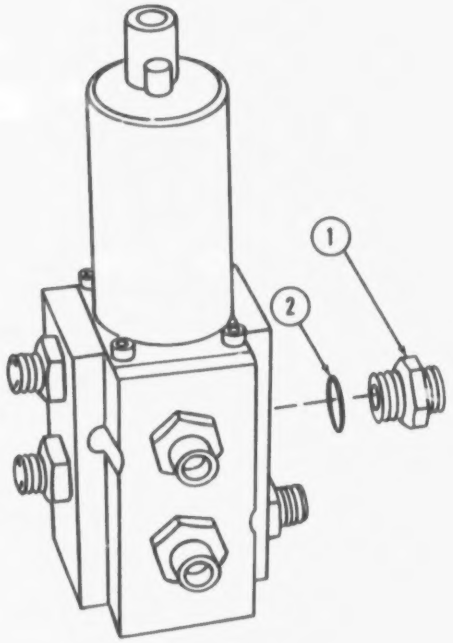
1 Inspect spring (10). Replace if cracked, **distorted**, scratched or tension is weak.

2 Inspect sleeve within solenoid (5) on valve body (6). Replace valve body (6) if sleeve is cracked or distorted.

3 Inspect valve spool (11). Replace entire elevation selector valve assembly if cracked or distorted.

4 Test electrical continuity of solenoid (5) with multimeter. Replace if defective.

c. Assembly



NOTE

Coat all internal parts with clean hydraulic fluid (Item 10, App. C) before assembly and avoid scratching finished surfaces.

1 Install two new rings (13) and two new preformed packings (12) on valve spool (11).

2 Insert valve spool (11) into valve body (6), being careful not to cut two new preformed packings (12).

3 Install spring (10) into valve body (6).

4 Install valve body plate (9), four new lock washers (8) and four socket head cap screws (7). Tighten socket head cap screws (7) evenly and gradually.

5 Place solenoid (5) on valve body (6).

WARNING

Solenoid must hold springs under high compression load. Restrain solenoid while assembling to avoid injury.

6 Install four new lock washers (4) and four socket head cap screws (3). Tighten four socket head cap screws (3) gradually and evenly.

7 Install six new preformed packings (2) and six straight reducers (1) on valve body (6).

8 Install elevation selector valve assembly (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

5-15 GUNNER'S CONTROL ASSEMBLY

This task covers: a. Removal b. Disassembly c. Assembly d. Installation

INITIAL SET-UP

Materials/Parts

Shims
Adhesive (Item 3, App. C)
Solder (Item 25, App. C)
Sealing compound (Item 19, app. C)
Preformed packings
Lock washers
Self locking nut

Special Tools

Solder gun (kit)

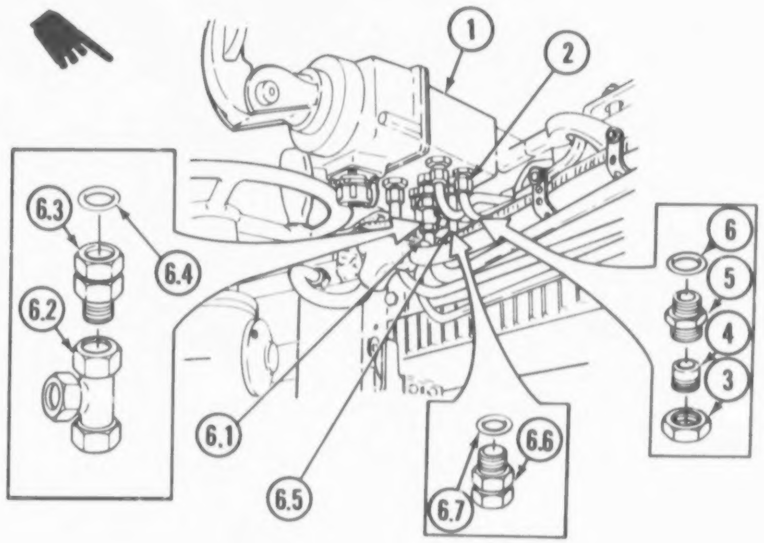
a. Removal

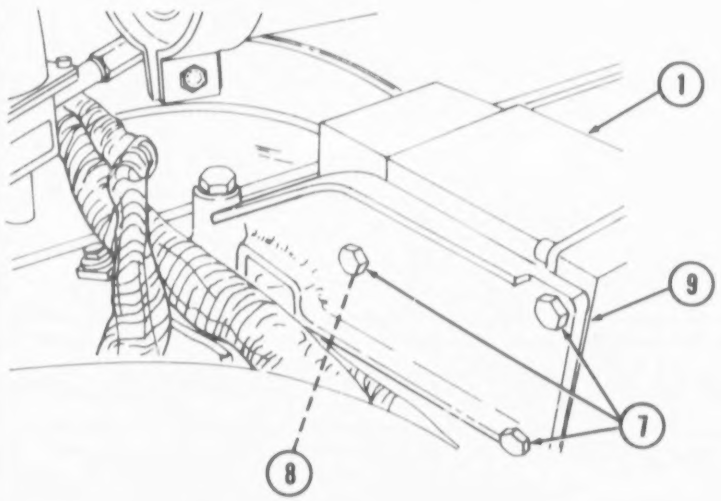
WARNING

Wear safety glasses and steel-tipped shoes to avoid possible injury while handling equipment.

1 Turn cab electrical power OFF.

2 Relieve cab hydraulic system pressure (ref. TM 9-2350-311-20-2).





NOTE

Steps 2.1 thru 2.3 apply to M109A4 howitzers only.

2.1 Disconnect four hydraulic lines (2), four hex nuts (3), four sleeves (4), four adapters (5), and four preformed packings (6) from bottom of gunner's control assembly (1). Discard four preformed packings.

2.2 Disconnect hydraulic line (6.1), tee (6.2), adapter (6.3), and preformed packing (6.4) from gunner's control assembly (1). Discard preformed packing.

2.3 Disconnect hydraulic line (6.5), adapter (6.6), and preformed packing (6.7) from gunner's control assembly (1). Discard preformed packing.

NOTE

Step 3 applies to M109A2/M109A3 howitzers.

3 Disconnect six hydraulic lines (2), six hex nuts (3), six sleeves (4), six adapters (5) and six preformed packings (6) from bottom of gunner's control assembly (1). Discard six preformed packings (6).

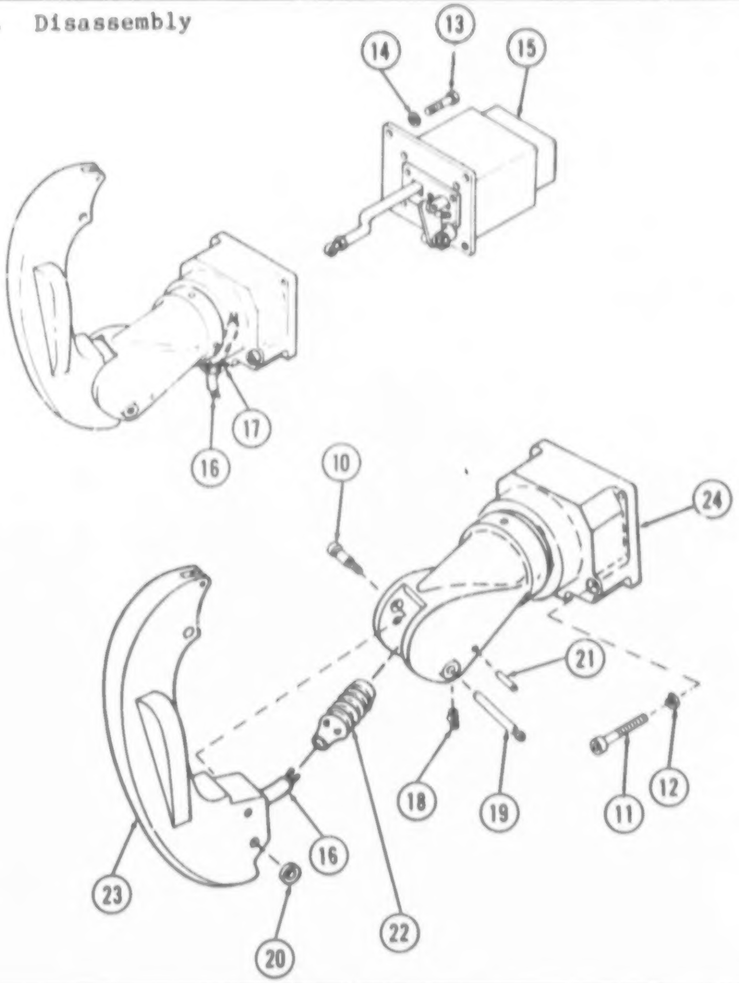
4 Remove three machine bolts (7) and one self-locking nut (8). Discard one self-locking nut (8).

5 Remove gunner's control assembly (1) from bracket (9).

CAB HYDRAULICS — Continued

5-15. GUNNER'S CONTROL ASSEMBLY – Continued

b. Disassembly



1 Remove shoulder screw (10) from control handle group (23) thru access hole in bracket and housing group (24).

2 Remove socket head cap screw (11) and lock washer (12) from lower rear corner of bracket and housing group (24). Discard lock washers (12).

3 Remove three screws (13), three lock washers (14) and control valve body group (15). Discard three lock washers (14).

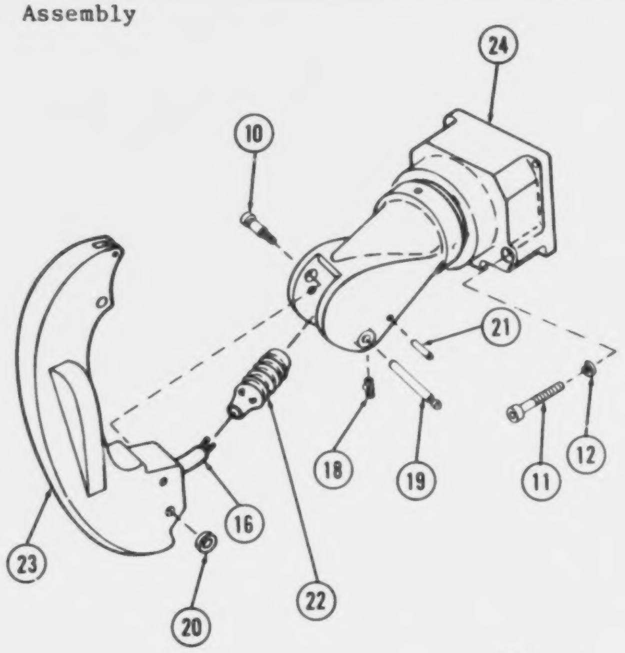
4 Unsolder non-functional electrical lead wires (16) from electrical receptacle (17), if attached.

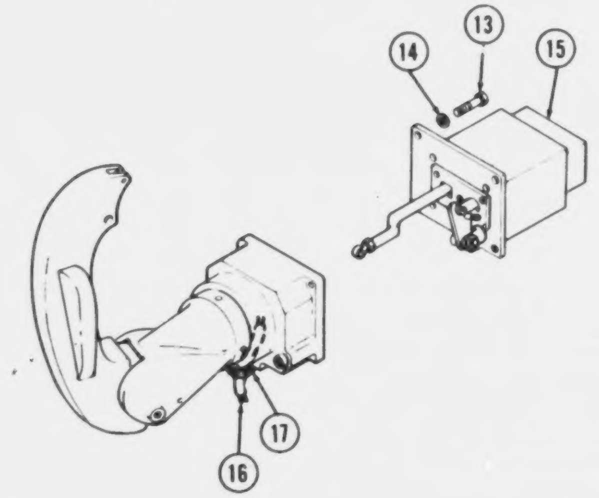
5 Remove setscrew (18), straight shaft (19), shims (20) and stop pin (21) from bracket and housing group (24).

6 Separate bellows (22) from adhesive bonding and remove.

7 Remove control handle group (23) from bracket and housing group (24).

c. Assembly





1 Install control handle group (23) to bracket and housing group (24).

2 Bond bellows (22) to bracket and housing group (24) with adhesive (Item 3, App. C).

3 Install stop pin (21), shims (20), straight shaft (19) and setscrew (18) to bracket and housing group (24). Shim as required up to a maximum of ten shims to obtain 0.003 to 0.008 inch (0.8 to 2.0 mm) total end play.

4 Solder (Item 25, App. C) lead wires (16) to electrical receptacle (17) in accordance with TB SIG 222.

5 Assemble control valve body group (15) to bracket and housing group (24) and secure with three new lock washers (14) and three screws (13).

6 Install new lock washer (12) and socket head cap screw (11) in lower rear corner of bracket and housing group (24).

7 Apply sealing compound (Item 19, App. C) to threads of shoulder screw (10) and install screw to control handle group (23) thru access hole in bracket and housing group (24).

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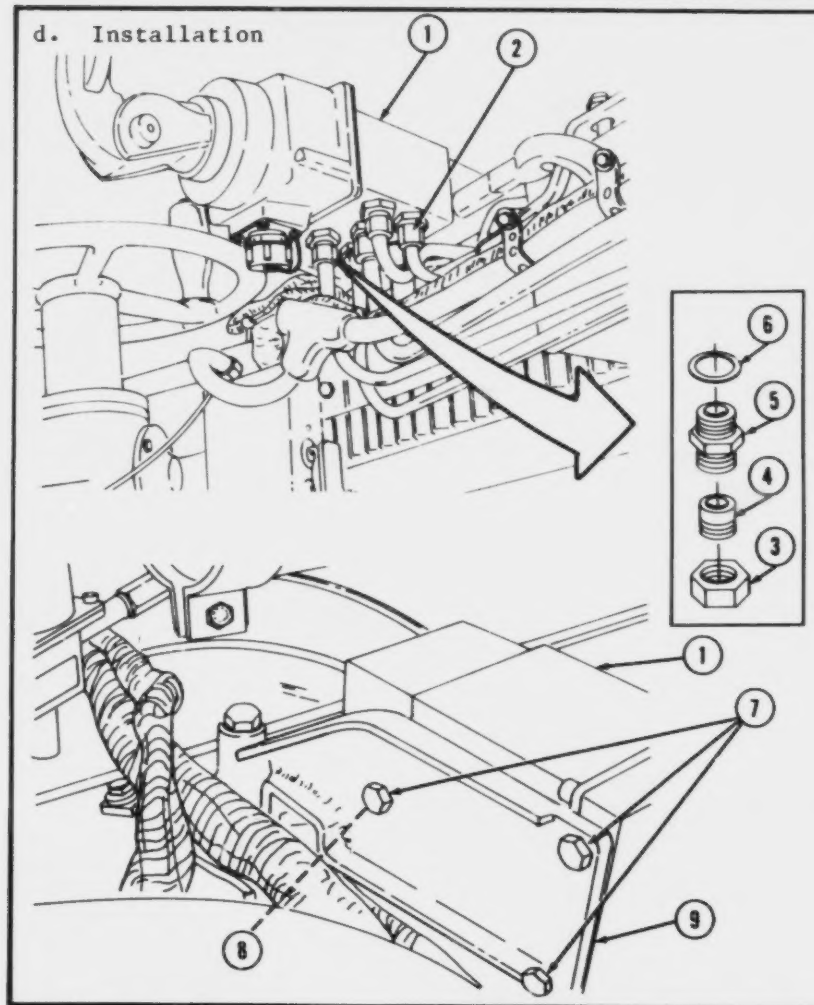
CAB HYDRAULICS — Continued

5-15 GUNNER'S CONTROL ASSEMBLY – Continued

d. Installation



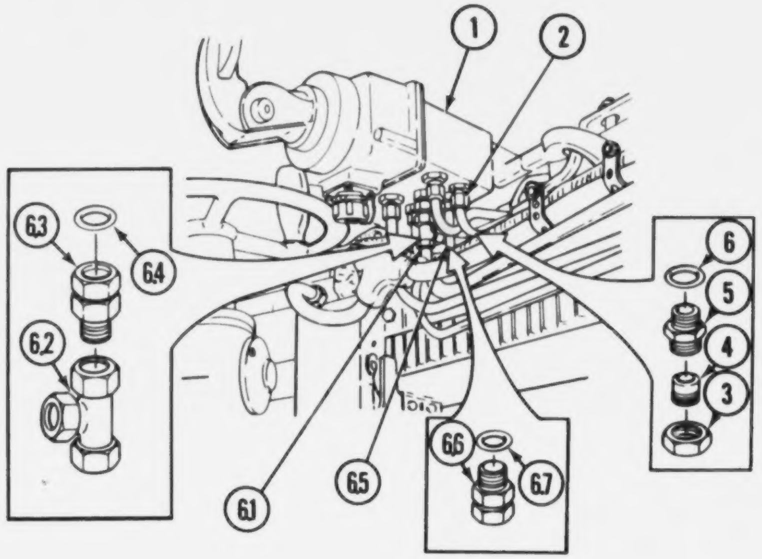
1 Place gunner's control assembly (1) in bracket (9).

2 Install one new self-locking nut (8) and three machine bolts (7).

NOTE

Step 3 applies to M109A2/M109A3 howitzers only.

3 Install six new preformed packings (6), six adapters (5), six sleeves (4), six hex nuts (3) and six hydraulic lines (2) to ports at bottom of left control assembly (1).



NOTE

Steps 3.1 thru 3.3 apply to M109A4 howitzers only.

3.1 Connect new preformed packing (6.7), adapter (6.6), and hydraulic line (6.5) to R port on bottom of gunner's control assembly (1).

3.2 Connect new preformed packing (6.4), adapter (6.3), tee (6.2), and hydraulic line (6.1) to S port on bottom of gunner's control assembly (1).

3.3 Connect four new preformed packings (6), four adapters (5), four sleeves (4), four hex nuts (3), and four hydraulic lines (2) to remaining ports at bottom of gunner's control assembly (1).

4 Turn cab electrical power ON.

5 Fill, charge and bleed cab hydraulic system (ref. TM 9-2350-311-20-2).

5-16. ASSISTANT GUNNER'S CONTROL ASSEMBLY

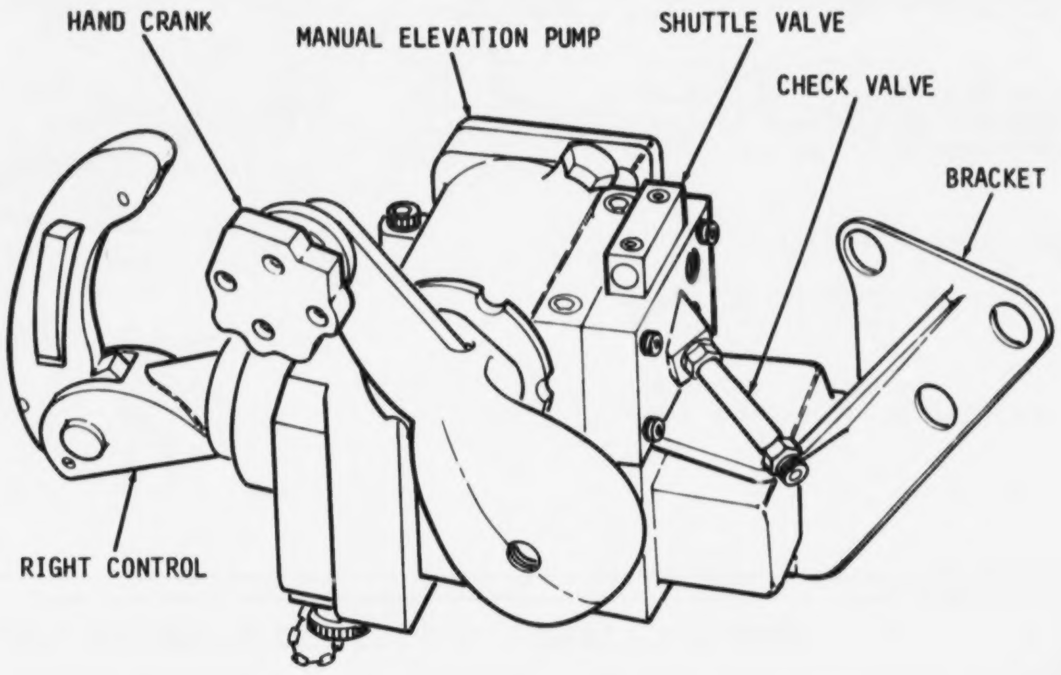
This task covers: a. Removal b. Disassembly c. Assembly d. Installation

INITIAL SET-UP

Materials/Parts

Preformed packings

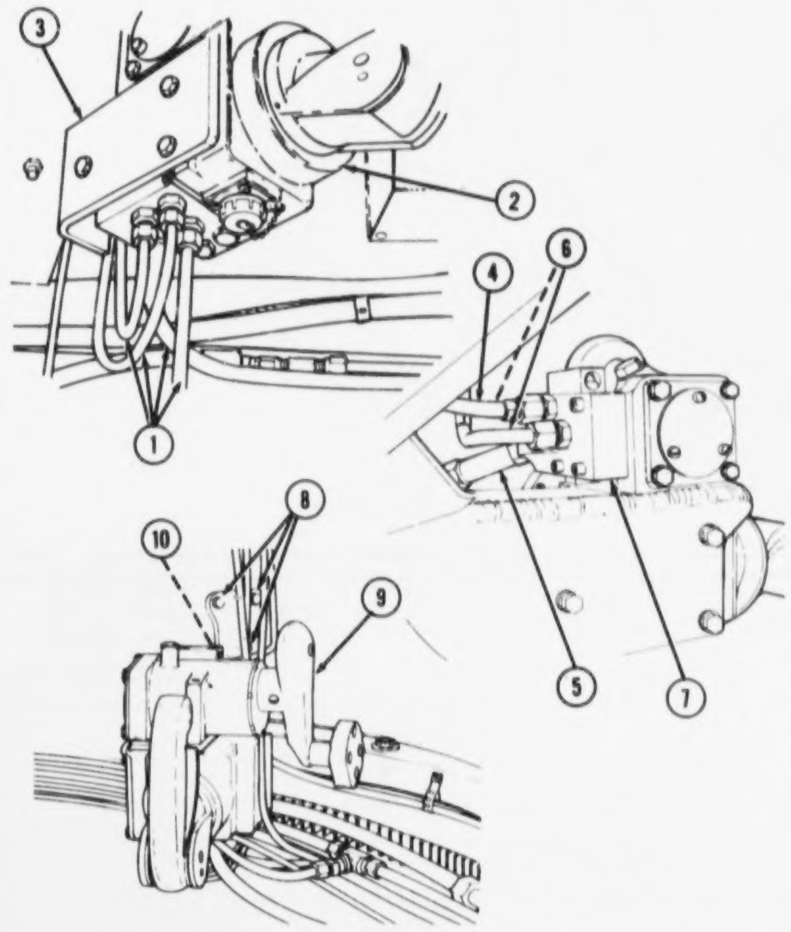
Lock washers


HAND CRANK
MANUAL ELEVATION PUMP
SHUTTLE VALVE
CHECK VALVE
BRACKET
RIGHT CONTROL

CAB HYDRAULICS — Continued

5-16 ASSISTANT GUNNER'S CONTROL ASSEMBLY – Continued

a. Removal



1 Secure cannon in TRAVEL LOCK position (ref. TM 9-2350-311-10-2).

2 Discharge pressure in cab hydraulic system. (ref. TM 9-2350-311-20-2).

3 Turn cab electrical power OFF (ref. TM 9-2350-311-10-2).

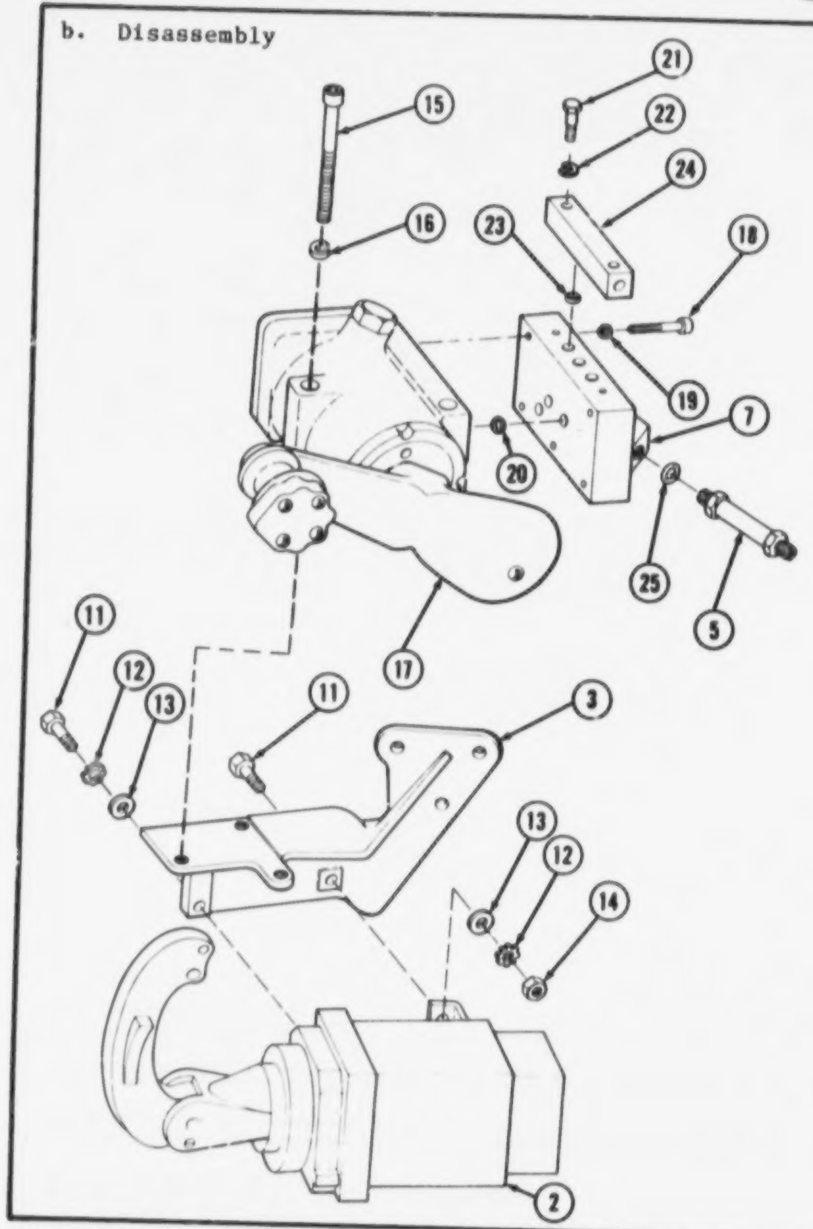
4 Disconnect four hydraulic tubes (1) from four ports on underside of assistant gunner's assembly (2). Catch dripping hydraulic fluid in suitable container.

5 Disconnect hydraulic tube (4) at check valve (5).

6 Disconnect two hydraulic tubes (6) at manifold (7).

7 Remove three screws (8), bracket (3) and elevation control assembly (9). Support elevation control assembly (9) as three screws (8) are removed from trunnion bracket (10).

b. Disassembly



1 Remove three machine bolts (11), three lock washers (12), three flat washers (13), three hex nuts (14) and assistant gunner's control assembly (2) from bracket (3). Discard three lock washers (12).

2 Remove three socket head cap screws (15), three lock washers (16) and manual pump hand crank (17) from bracket (3). Discard three lock washers (16).

3 Remove five socket head cap screws (18), five lock washers (19), three preformed packings (20) and manifold (7) from manual pump hand crank (17). Discard three preformed packings (20). Discard five lock washers (19).

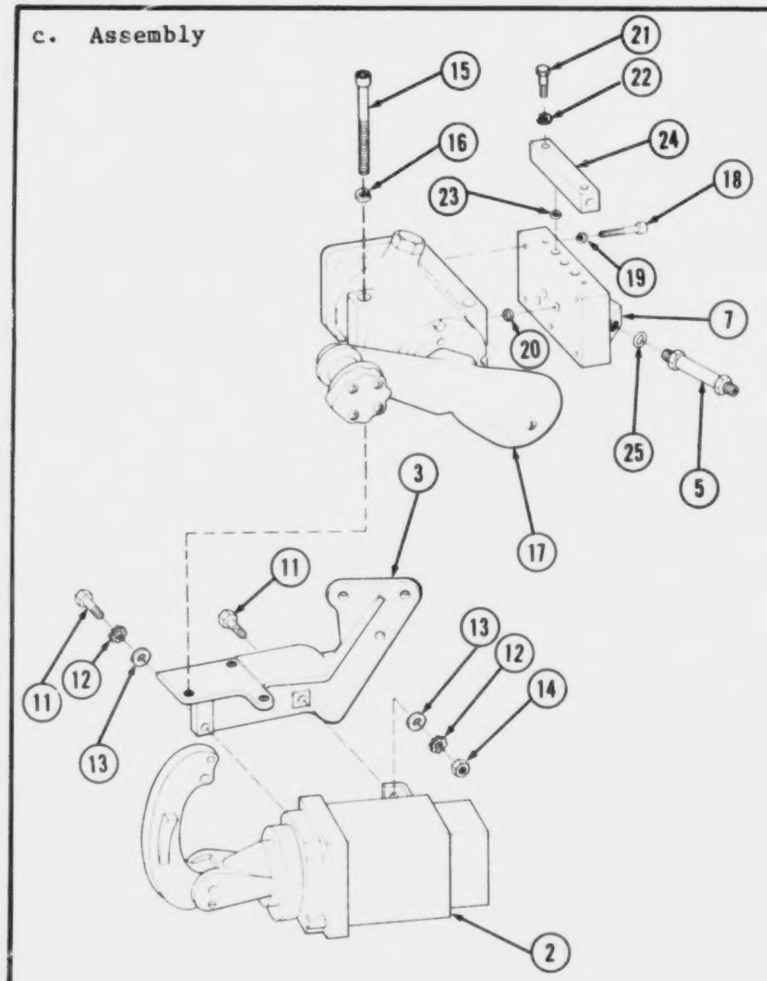
4 Remove two screws (21), two lock washers (22), three preformed packings (23) and shuttle valve (24) from manifold (7). Discard three preformed packings (23). Discard two lock washers (22).

5 Remove check valve (5) and preformed packing (25) from manifold (7). Discard preformed packing (25).

CAB HYDRAULICS — Continued

5-16. ASSISTANT GUNNER'S CONTROL ASSEMBLY – Continued

c. Assembly



1 Install new preformed packing (25) and check valve (5) in manifold (7).

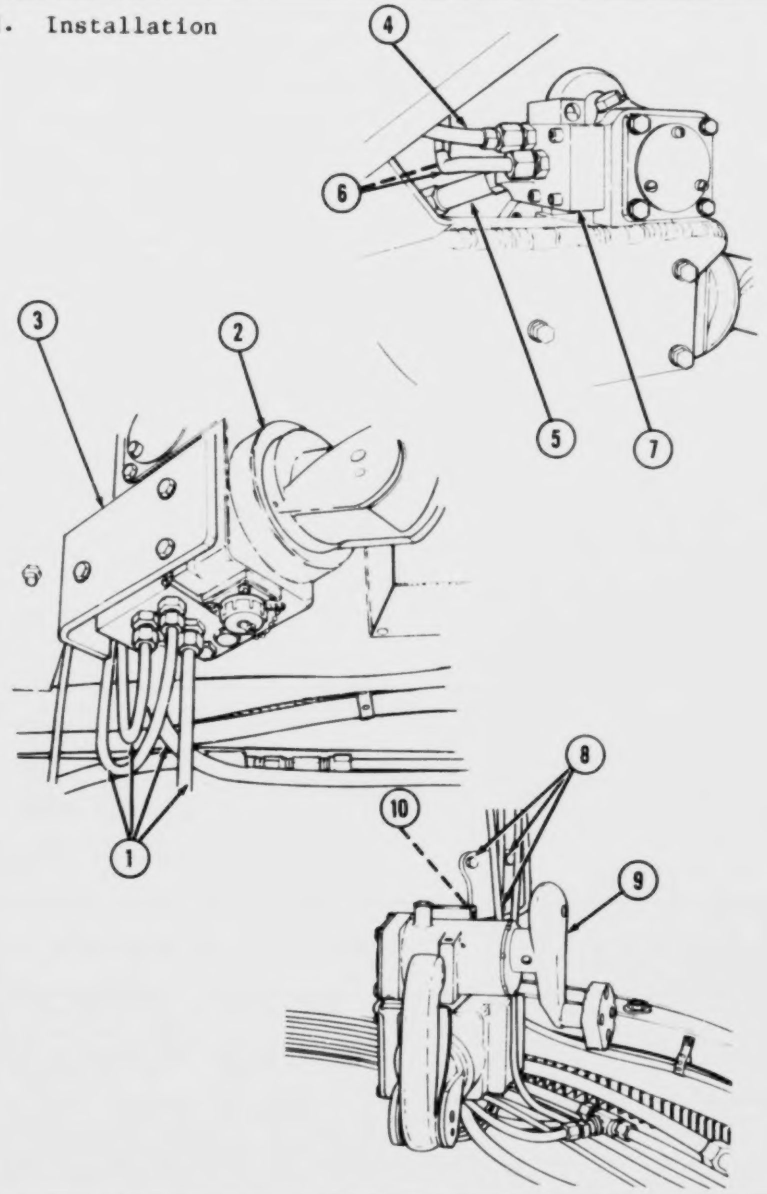
2 Install shuttle valve (24), three new preformed packings (23), two new lock washers (22) and two screws (21) on manifold (7).

3 Install manifold (7), three new preformed packings (20), five new lock washers (19) and five socket head cap screws (18) on manual pump hand crank (17).

4 Install manual pump hand crank (17), three new lock washers (16) and three socket head cap screws (15) on bracket (3).

5 Install assistant gunner's control assembly (2), three hex nuts (14), three lock washers (12), three flat washers (13) and three machine bolts (11) on bracket (3).

d. Installation



1 Aline holes in trunnion bracket (10), elevation control assembly (9) and bracket (3). Secure all components with three screws (8).

2 Connect two hydraulic tubes (6) to manifold (7).

3 Connect hydraulic tube (4) to check valve (5).

4 Connect four hydraulic tubes (1) to four ports on underside of assistant gunner's control assembly (2).

5 Turn cab electrical power ON (ref. TM 9-2350-311-10-2).

6 Refill, charge and bleed cab hydraulic system (ref. TM 9-2350-311-20-2).

CAB HYDRAULICS — Continued

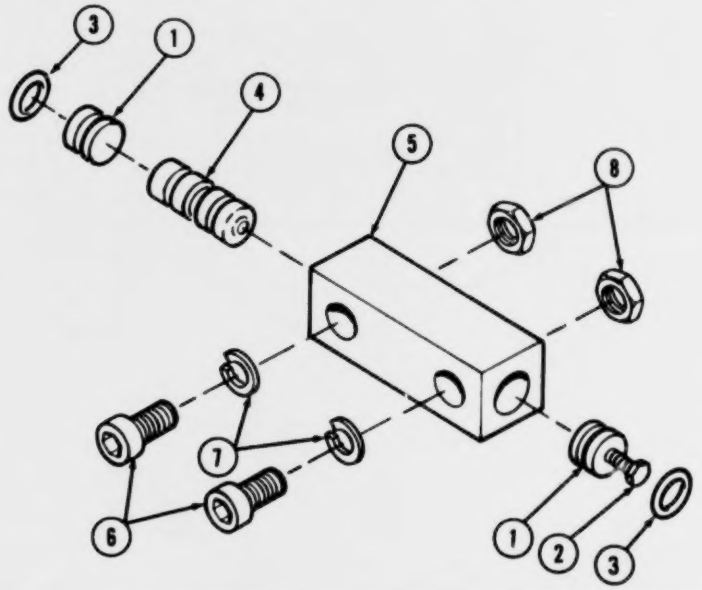
5-17. SHUTTLE VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts
Repair parts kit P/N 5704210
Preformed packings
Lock washers

a. Disassembly



1 Remove shuttle valve (ref. page 5-163).

2 Remove two end plugs (1) by screwing a No. 4-40 screw (2) into each end plug (1) and pulling out of spool (4).

3 Remove and discard two preformed packings (3).

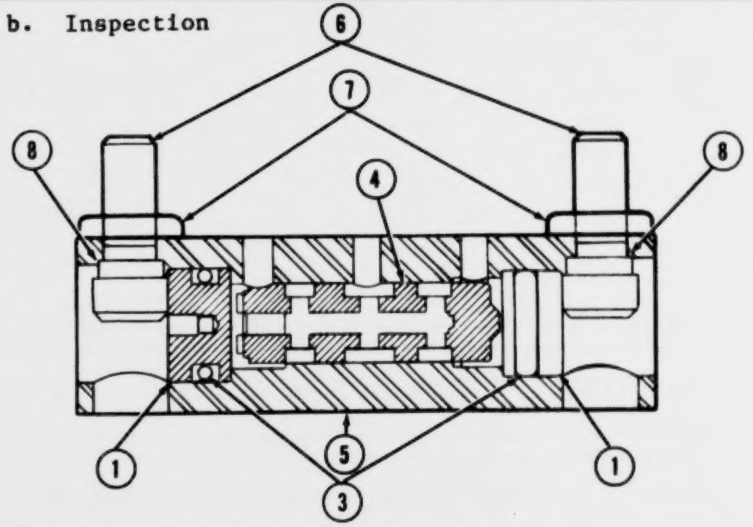
4 Remove spool (4) from body (5).

NOTE

If shuttle valve is not to be installed immediately, use mounting screws, lock washers and nuts to retain parts.

5 Install two mounting screws (6), two lock washers (7) and two nuts (8), if required to retain parts.

b. Inspection



1 Inspect two end plugs (1). Replace if cracked, distorted or outside diameter is less than 0.434 inch (11 mm).

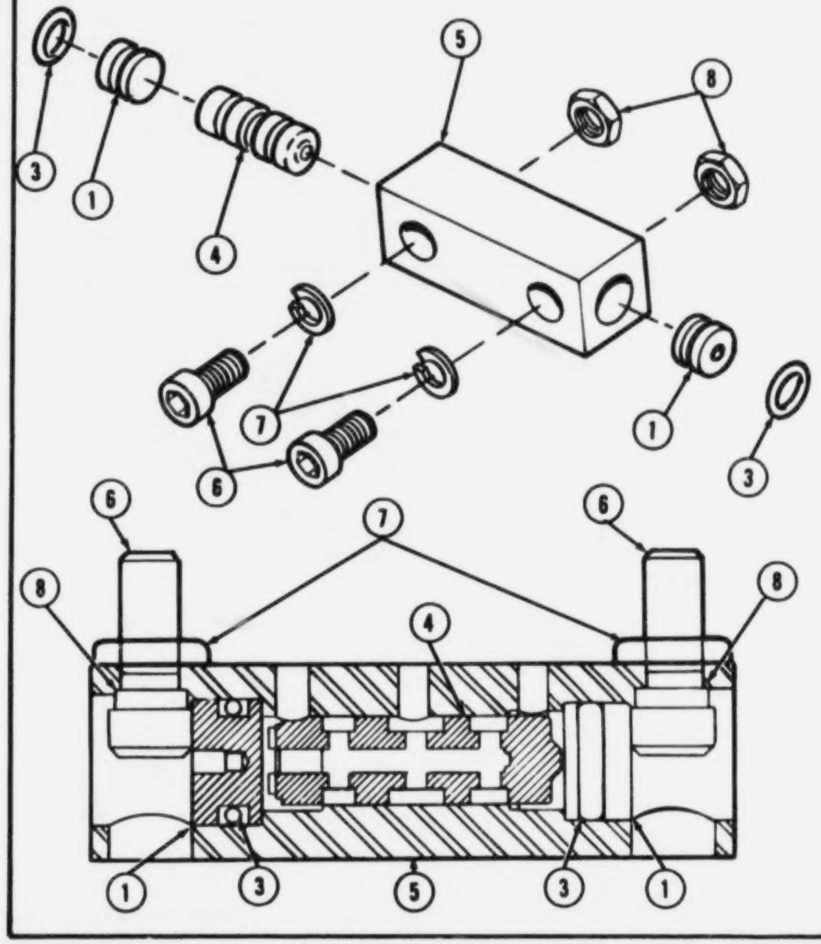
2 Inspect spool (4). Replace if scratched, cracked or outside diameter is less than 0.317 inch (8 mm).

3 Inspect body (5). Replace if cracked, distorted, damaged or if fit of spool (4) in hole is greater than 0.005 inch (0.127 mm).

CAB HYDRAULICS — Continued

5-17. SHUTTLE VALVE ASSEMBLY — Continued

c. **Assembly**



1 Remove two nuts (8), two lock washers (7) and two mounting screws (6) if used to retain parts.

2 Install spool (4) in body (5).

3 Install two new preformed packings (3) on two end plugs (1).

4 Install two end plugs (1) in body (5), being careful not to cut two new preformed packings (3).

5 Install shuttle valve (ref. page 5-163).

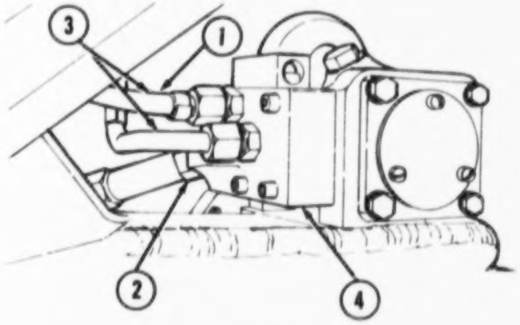
5-18. MANUAL ELEVATION PUMP ASSEMBLY

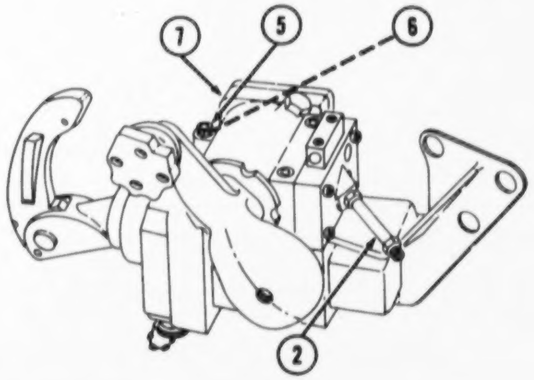
This task covers: a. Removal b. Installation

INITIAL SET-UP

Materials/Parts
Lock washers

a. Removal





1 Apply vehicle parking brake.

2 Turn cab electrical power OFF.

3 Secure cannon in TRAVEL LOCK position.

4 Discharge pressure in cab hydraulic system (ref. TM 9-2350-311-20-2).

5 Disconnect hydraulic tube (1) at check valve (2). Catch draining hydraulic fluid in a suitable container.

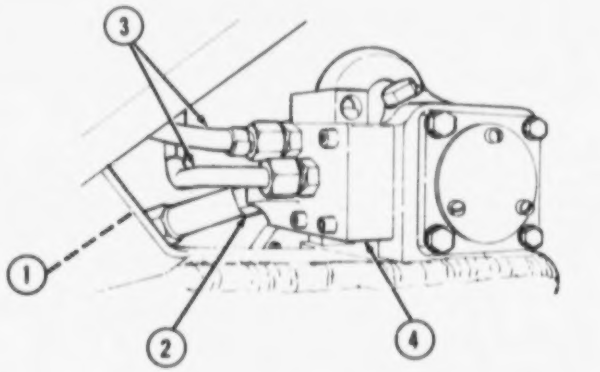
6 Disconnect two hydraulic tubes (3) at rear of manifold (4). Catch draining hydraulic fluid in a suitable container.

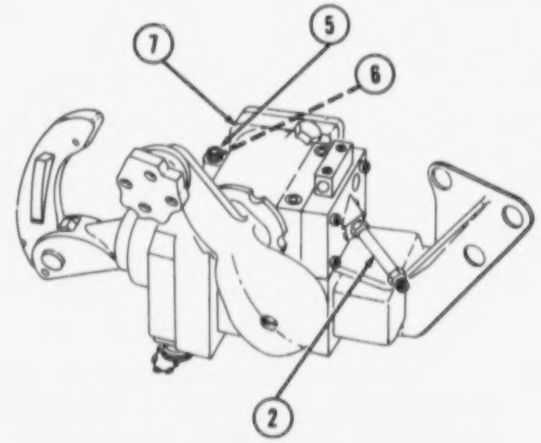
7 Remove three screws (5) and three lock washers (6) from top of manual elevation pump (7). Lift manual elevation pump (7) off bracket (ref. page 5-164). Discard three lock washers (6).

CAB HYDRAULICS — Continued

5-18. MANUAL ELEVATION PUMP ASSEMBLY – Continued

b. Installation





1 Place manual elevation pump (7) on bracket (ref. page 5-164). Install three new lock washers (6) and three screws (5) to secure manual elevation pump (7).

2 Connect two hydraulic tubes (3) to rear of manifold (4).

3 Connect hydraulic tube (1) to check valve (2).

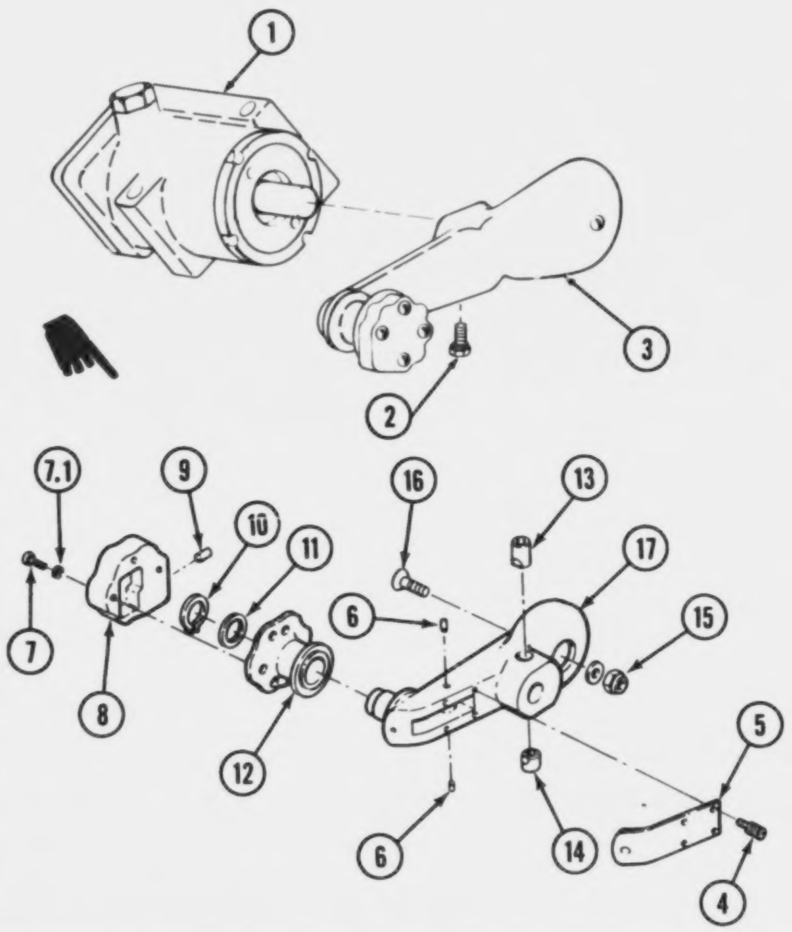
4 Fill, charge and bleed cab hydraulic system (ref. TM 9-2350-311-20-2).

5 Turn cab electrical power ON.

5-19. MANUAL ELEVATION PUMP HANDLE ASSEMBLY

This task covers: a. Disassembly b. Assembly

a. Disassembly



1 Remove manual elevation pump handle assembly (1) from vehicle.

2 Remove check valve, shuttle valve and manifold from manual elevation pump handle assembly (1) (ref. page 5-163).

3 Remove hex head cap screw (2) and elevating arm assembly (3) from manual elevation pump handle assembly (1).

4 Remove five assembled washer screws (4) and access cover (5).

5 Remove two plugs (6) from elevating arm (17).

6 Remove four screws (7), four lock washers (7.1), and knob cap (8). Discard lock washers.

7 Remove plug (9) from knob cap (8).

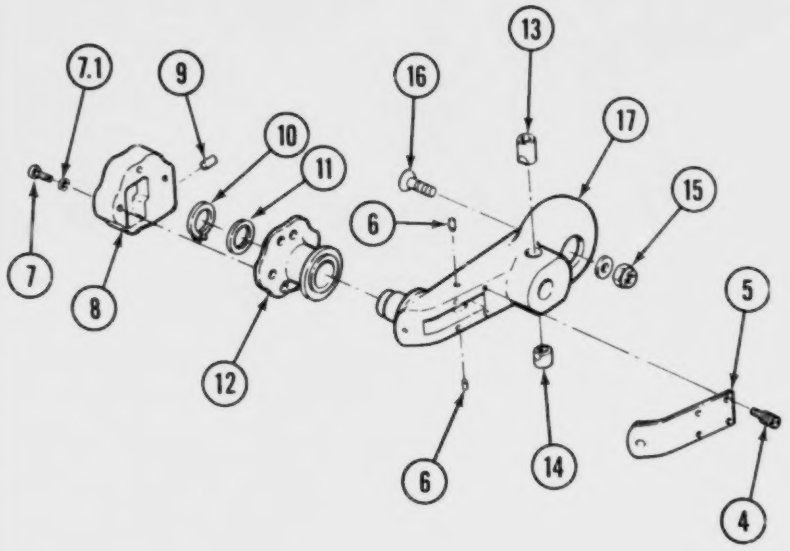
8 Remove retaining ring (10), ring spacer (11) and knob (12) from elevating arm (17).

9 Remove plain round nut (13), shaft collar (14), nut (15) and screw (16) from elevating arm (17).

CAB HYDRAULICS — Continued

5-19. MANUAL ELEVATION PUMP HANDLE ASSEMBLY – Continued

b. Assembly



1 Install screw (16), nut (15), shaft collar (14) and plain round nut (13) on elevating arm (17).

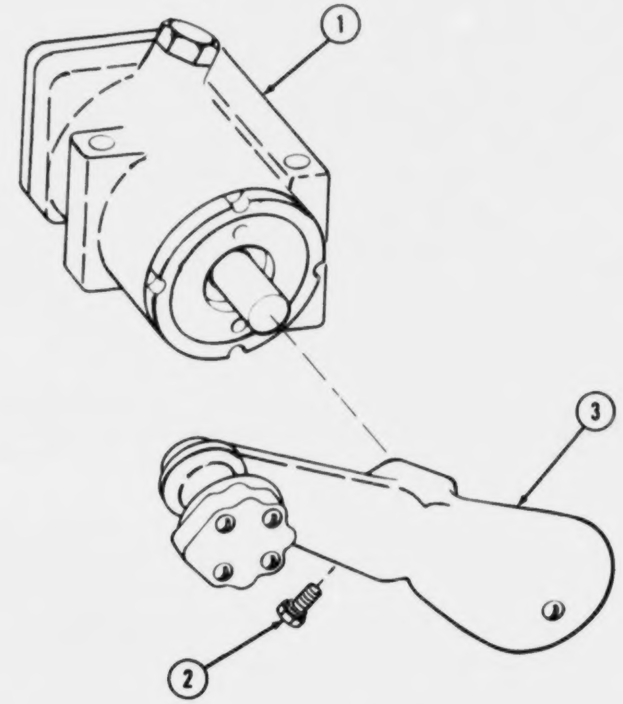
2 Install knob (12), ring spacer (11) and retaining ring (10) on elevating arm (17).

3 Install plug (9) in knob cap (8).

4 Install knob cap (8), four new lock washers (7.1) and four screws (7) to knob (12).

5 Install two plugs (6) to elevating arm (17).

6 Install access cover (5) and five assembled washer screws (4).



7 Install elevating arm assembly (3) to manual elevation pump handle assembly (1). Secure with hex head cap screw (2).

8 Install manifold, shuttle valve and check valve to manual elevation pump handle assembly (1) (ref. page 5-164).

9 Install manual elevation pump handle assembly (1) in vehicle.

CAB HYDRAULICS — Continued

5-20. MANUAL ELEVATION PUMP HOUSING AND BLOCK GROUP

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts
Repair parts kit P/N 5704210
Lock washers

a. Disassembly

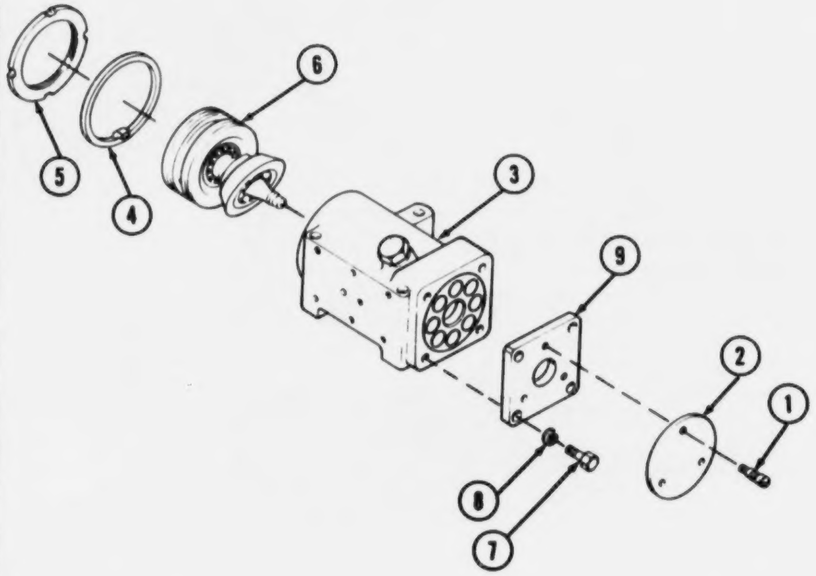
WARNING

Use extreme caution when removing bearing retainer because of spring-loaded components within housing. Restrain shaft and retainer during disassembly by placing in vise or C-clamp.

1 Remove manual elevation pump assembly from vehicle (ref. page 5-171).

2 Remove check valve, shuttle valve and manifold from manual elevation pump assembly (ref. page 5-163).

3 Remove manual elevation pump assembly (ref. page 5-163).



4 Remove three screws (1) and cover (2) from pump housing and block group (3).

5 Disengage tab of key washer (4) from slot in plain round nut (5).

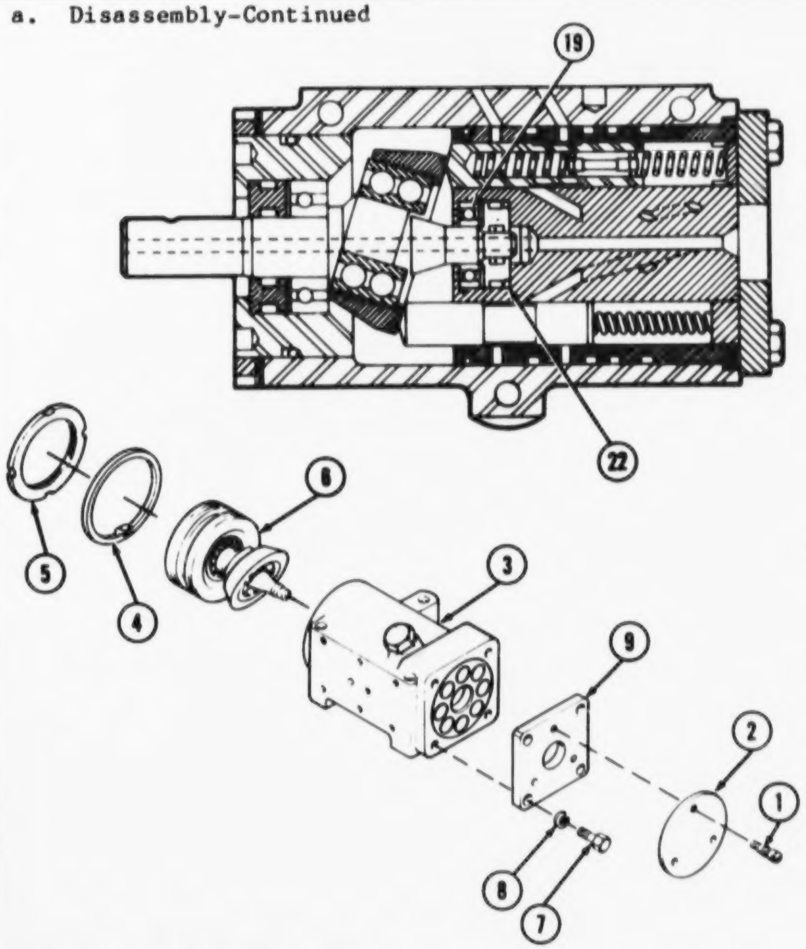
6 Remove plain round nut (5).

7 Remove key washer (4).

CAB HYDRAULICS — Continued

5-20. MANUAL ELEVATION PUMP HOUSING AND BLOCK GROUP – Continued

a. Disassembly-Continued



8 Inner ball bearing (19) and bearing sleeve spacer (22) may come out with bearing retainer, pump shaft, slide and bearing group (6).

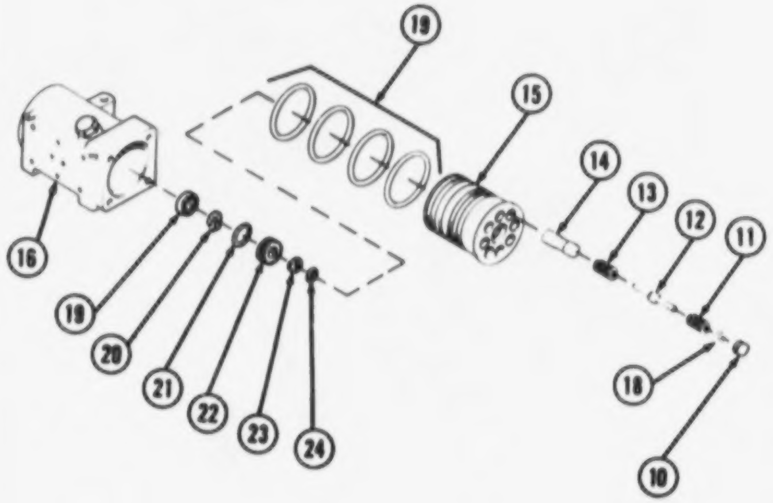
9 Remove bearing retainer, pump shaft, slide and bearing group (6) from pump housing and block group (3).

10 Remove four hex head cap screws (7), four lock washers (8) and access cover (9). Discard four lock washers (8).

11 Remove eight pump retainers (10).

12 Remove and discard eight piston springs (11).

13 Remove and discard eight piston spring guides (12).



14 Remove and discard eight piston springs (13).

15 Remove eight pistons (14).

16 Withdraw block group (15) from pump housing (16).

17 Remove and discard four preformed packings (17) from block group (15).

18 Remove and discard eight preformed packings (18) from eight pump retainers (10).

19 Remove inner ball bearing (19) if it did not come out with bearing retainer, pump shaft, slide and bearing group (6) in Step 8.

20 Remove and discard retaining ring (20).

21 Remove and discard preformed packing (21).

22 Remove bearing sleeve spacer (22).

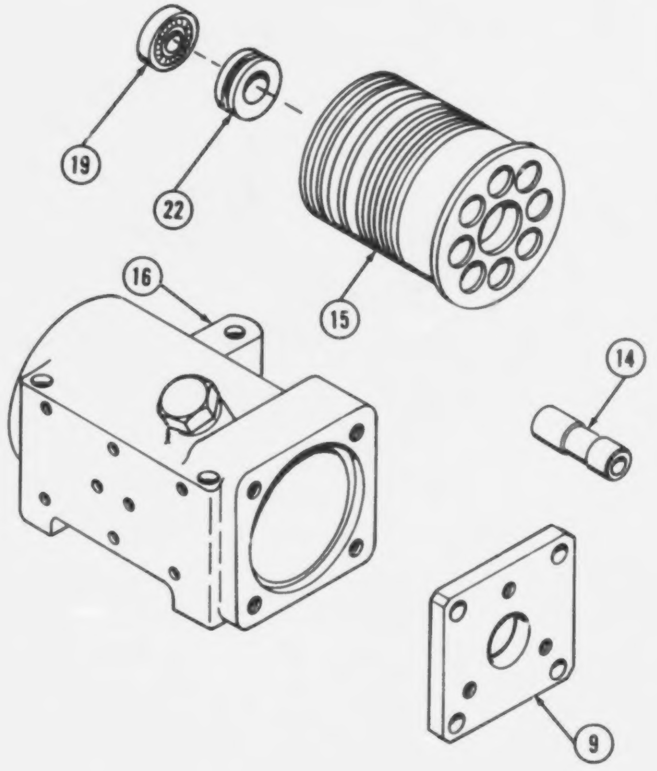
23 Remove and discard packing retainer (23) from inside bearing sleeve spacer (22).

24 Remove and discard preformed packing (24) from inside bearing sleeve spacer (22).

CAB HYDRAULICS — Continued

5-20. MANUAL ELEVATION PUMP HOUSING AND BLOCK GROUP – Continued

b. Inspection



1 Inspect inner ball bearing (19) (ref. TM 9-214).

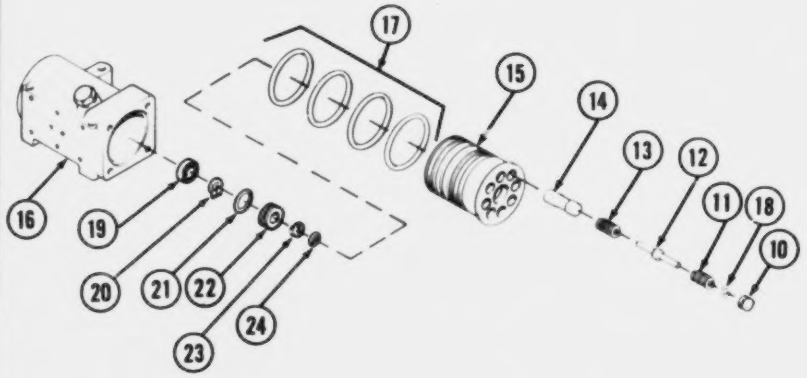
2 Replace bearing sleeve spacer (22) if outside diameter is less than 0.871 inch (22 mm) or inside diameter is greater than 0.38 inch (10 mm).

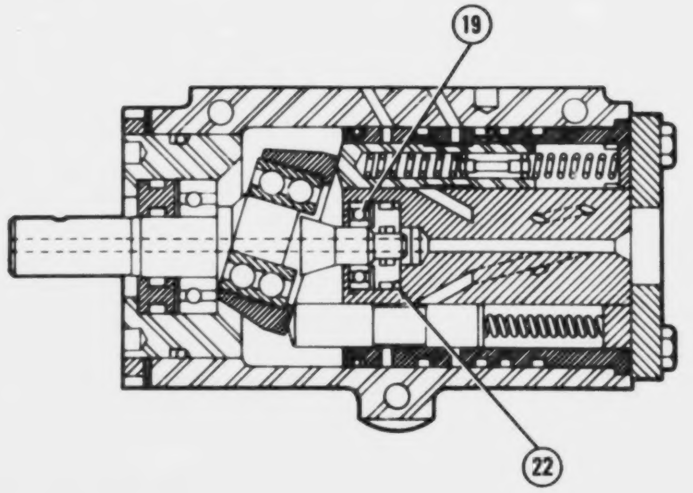
3 Inspect block group (15). Replace if any cylinder bore inside diameter is greater than 0.501 inch (13 mm).

4 Inspect entire block and piston assembly. Replace if any piston (14) outside diameter is more than 0.001 inch (0.025 mm) less than its respective numbered piston bore inside diameter. (Example: If piston bore is 0.500 inch (12.7 mm), then outside diameter must be between 0.499 and 0.4999 inch (12.6 and 12.69 mm)).

5 Inspect access cover (9) and pump housing (16). Replace if cracked, distorted or damaged.

c. Assembly





1 Install new preformed packing (24) inside bearing sleeve spacer (22).

2 Install new packing retainer (23) inside bearing sleeve spacer (22). Be sure that new packing retainer (23) is toward end of shaft.

3 Install bearing sleeve spacer (22).

4 Install new preformed packing (21).

5 Install new retaining ring (20).

6 Install inner ball bearing (19).

7 Install eight new preformed packings (18) in eight pump retainers (10).

8 Install four new preformed packings (17).

9 Install block group (15) in pump housing (16).

10 Install eight pistons (14).

11 Install eight new piston springs (13).

12 Install eight new piston spring guides (12).

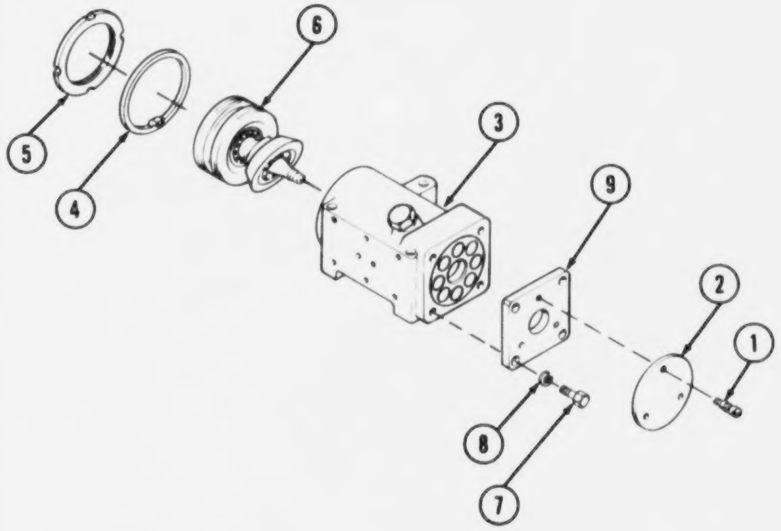
13 Install eight new piston springs (11).

14 Install eight pump retainers (10).

CAB HYDRAULICS — Continued

5-20. MANUAL ELEVATION PUMP HOUSING AND BLOCK GROUP — Continued

c. Assembly-Continued



15 Install access cover (9), four new lock washers (8) and four hex head cap screws (7).

WARNING

Use extreme caution when installing bearing retainer because of spring-loaded components within pump housing. Restrain pump shaft and bearing retainer during assembly by placing in vise or C-clamp.

16 Install bearing retainer, pump shaft, slide and bearing group (6) in pump housing and block group (3).

17 Install key washer (4).

18 Install plain round nut (5).

19 Bend tab of key washer (4) to engage slot in plain round nut (5).

20 Install cover (2) and three screws (1) on pump housing and block group (3).

21 Install manual elevation pump handle assembly (ref page 5-173).

22 Install manifold, shuttle valve and check valve (ref page 5-164).

23 Install manual elevation pump handle assembly on vehicle (ref. page 5-164).

CAB HYDRAULICS — Continued

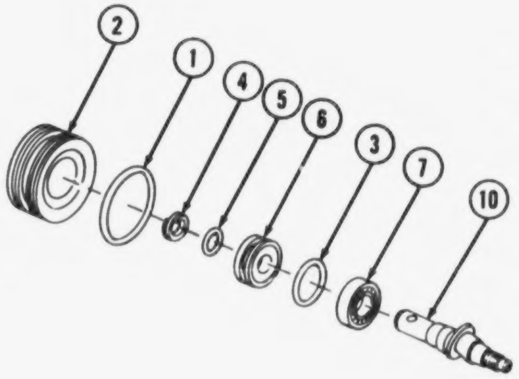
5-21. MANUAL ELEVATION PUMP SHAFT, SLIDE AND BEARING GROUP

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts
Repair parts kit P/N 5704210

a. Disassembly

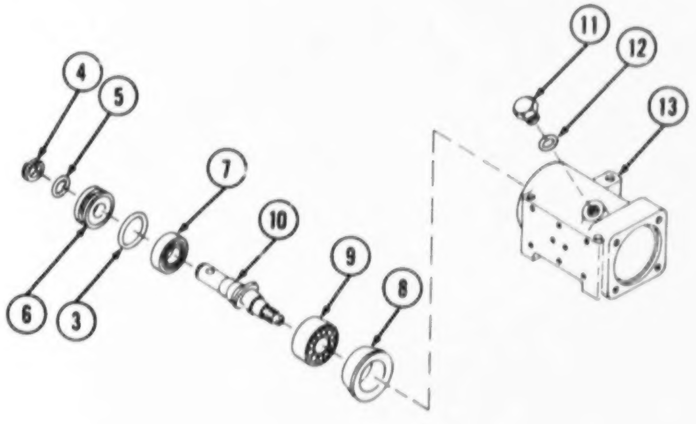


1 Remove manual elevation pump shaft, slide and bearing group from pump housing and block group (ref. page 5-176).

2 Remove and discard preformed packing (1) from cover retainer (2).

3 Remove cover retainer (2) from pump shaft (10).

4 Remove preformed packing (3), packing retainer (4), preformed packing (5) and sleeve spacer (6) as an assembly.



5 Remove and discard preformed packing (3) from outside of sleeve spacer (6).

6 Remove and discard packing retainer (4) and preformed packing (5) from inside of sleeve spacer (6).

7 Remove outer ball bearing (7) from pump shaft (10).

8 Remove hydraulic slide (8) from shaft slide bearing (9).

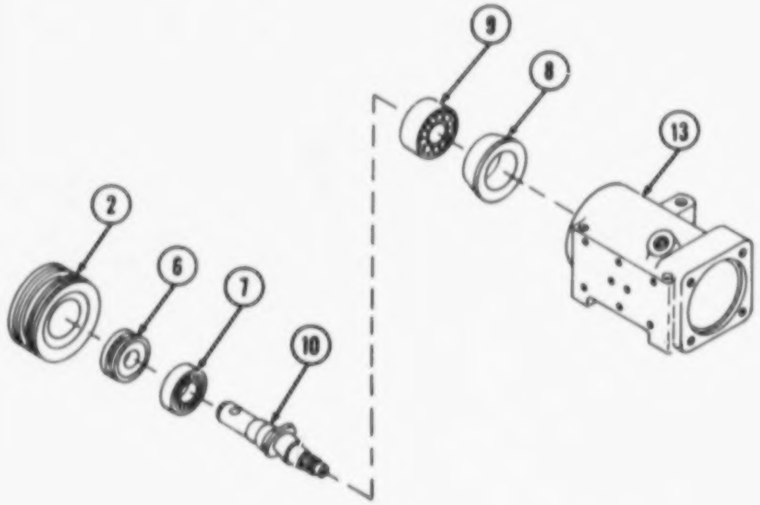
9 Remove shaft slide bearing (9) from pump shaft (10).

10 Remove bleed plug (11) and preformed packing (12) from bleeder hole in housing (13). Discard preformed packing (12).

CAB HYDRAULICS — Continued

5-21. MANUAL ELEVATION PUMP SHAFT, SLIDE AND BEARING GROUP – Continued

b. Inspection



1 Inspect cover retainer (2). Replace if inside diameter is less than 1.387 inches (35.2 mm).

2 Inspect pump shaft (10). Replace if outside diameter is less than 0.668 inch (7 mm).

3 Inspect sleeve spacer (6). Replace if outside diameter is less than 1.37 inch (35 mm) or inside diameter is greater than 0.673 inch (17 mm).

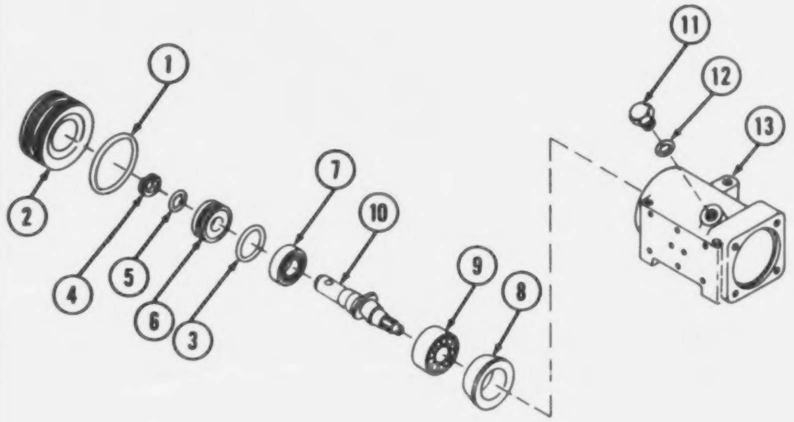
4 Inspect outer ball bearing (7) (ref. TM 9-214).

5 Inspect hydraulic slide (8). Replace if inside diameter is greater than 1.57 inch (40 mm).

6 Inspect shaft slide bearing (9) (ref. TM 9-214).

7 Inspect housing (13). Replace if cracked, distorted or damaged.

c. Assembly



1 Install new preformed packing (12) and bleed plug (11) in bleeder hole of housing (13).

2 Install shaft slide bearing (9) onto pump shaft (10) to within 0.25 inch (6.35 mm) of pump shaft (10) shoulder.

3 Install hydraulic slide (8) on shaft slide bearing (9).

4 Install outer ball bearing (7) on pump shaft (10).

5 Install new preformed packing (5) and new packing retainer (4) on inside of sleeve spacer (6). Be sure that new packing retainer (4) is seated in inner recess of sleeve spacer (6) and is facing toward the end of pump shaft (10).

6 Install new preformed packing (3) on outside of sleeve spacer (6).

7 Install sleeve spacer (6). new preformed packing (5), new packing retainer (4) and new preformed packing (3) as an assembly.

8 Install cover retainer (2) on pump shaft (10).

9 Install new preformed packing (1) on cover retainer (2).

10 Install manual elevation pump shaft, slide and bearing group to pump housing and block group.

5-22. GUNNER'S/ASSISTANT GUNNER'S CONTROL ASSEMBLY HANDLES

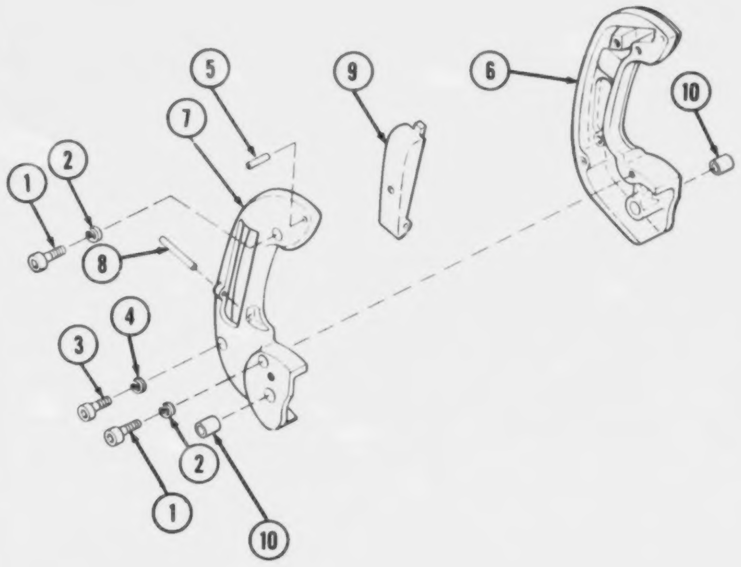
This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts

Lockwashers

a. Disassembly



NOTE

Handle assemblies of left and right control are identical procedures for service.

1 Before disassembling gunner's/assistant gunner's control assembly handles, remove gunner's control assembly (ref. page 5-157) and assistant gunner's control assembly (ref. page 5-163).

2 Remove two socket head cap screws (1) and two lock washers (2). Discard two lock washers (2).

3 Remove socket head cap screw (3) and lock washer (4). Discard lock washer (4).

4 Drive out straight headless pin (5).

a. Disassembly

5 Separate left and right handle halves (6 and 7).

6 Drive out straight headless pin (8). Remove actuator (9).

7 Remove two sleeve bushings (10) from left and right handle halves (6 and 7) only if necessary.

b. Inspection

1 Inspect straight headless pins (5 and 8). Replace if bent or cracked.

2 Inspect left and right handle halves (6 and 7) and actuator (9). Replace if broken or cracked.

c. Assembly

1 Install one sleeve bushing (10) in left handle half (6) and one sleeve bushing (10) in right handle half (7).

2 Install actuator (9) and straight headless pin (8) in assistant gunner's handle half (7).

3 Assemble left and right handle halves (6 and 7) and install straight headless pin (5).

4 Install new lock washer (4) and socket head cap screw (3).

5 Install two new lock washers (2) and two socket head cap screws (1).

6 Install gunner's control assembly (ref. page 5-160) and assistant gunner's control assembly (ref. page 5-164).

CAB HYDRAULICS — Continued

5-23. BRACKET, CAM AND HOUSING GROUP

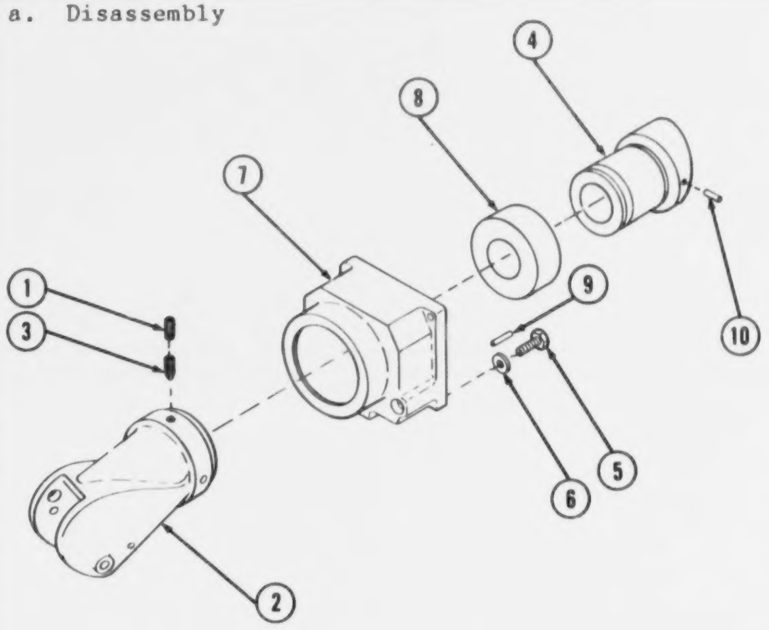
This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts

Sealing compound (Item 19, App. C)
Grease (Item 9, App. C)

a. Disassembly



1 Before disassembling bracket, cam and housing group, remove gunner's control assembly (ref. page 5-157).

2 Remove three flat setscrews (1) from bracket (2).

3 Remove three cup point setscrews (3) from bracket (2).

4 Remove bracket (2) from control cam (4).

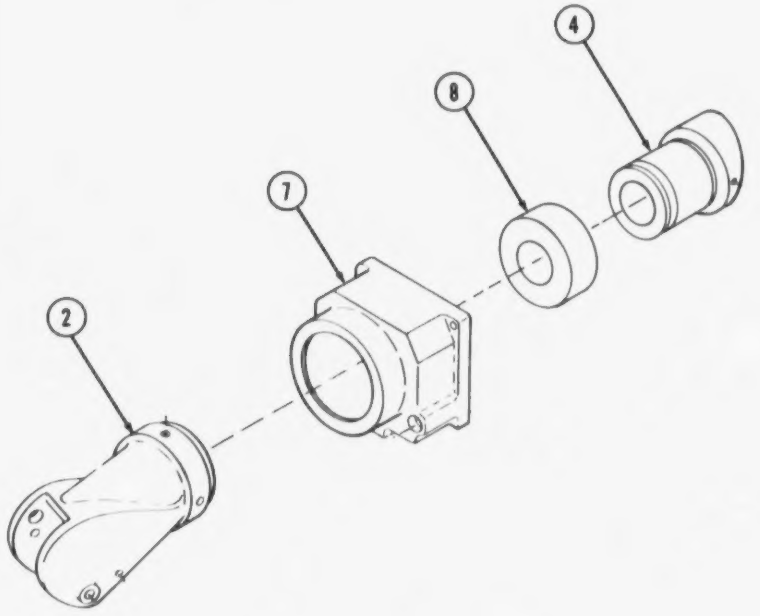
5 Withdraw control cam (4), four screws (5) and four flat washers (6) from housing (7).

6 Remove control cam roller bearing (8).

7 Remove two stop pins (9) from housing (7).

8 Remove control cam pin (10) from control cam (4).

b. Inspection



1 Smooth all burrs on control cam (4).

2 Inspect control cam roller bearing (8) (ref. TM 9-214).

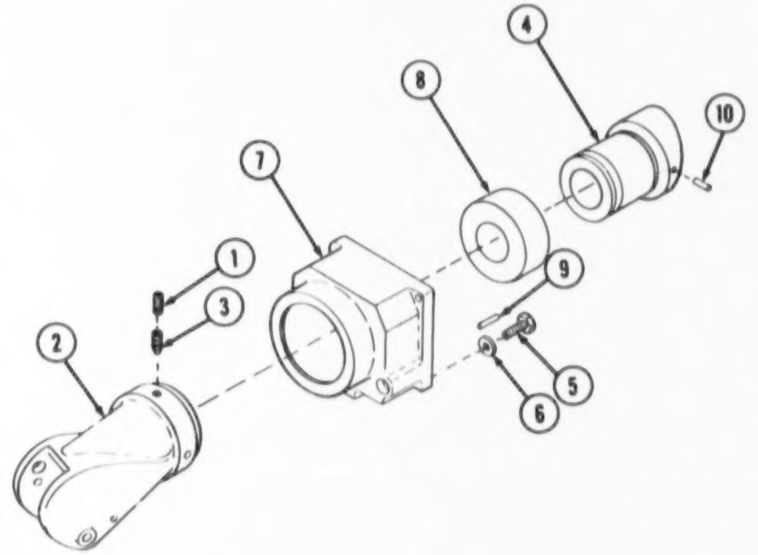
3 Inspect inside surface of housing (7). Repair if scratched or burred.

4 Inspect bracket (2). Replace if cracked, distorted or damaged.

CAB HYDRAULICS — Continued

5-23. BRACKET, CAM AND HOUSING GROUP – Continued

c. Assembly



1 Install control cam pin (10) in control cam (4).

2 Install two stop pins (9) in housing (7).

3 Lubricate control cam roller bearing (8) with grease (Item 9, App. C).

4 Install control cam roller bearing (8) in housing (7).

5 Install four flat washers (6).

6 Apply sealing compound (Item 19, App. C) to threads of four screws (5).

7 Install four screws (5).

8 Install control cam (4) in housing (7).

9 Attach bracket (2) to control cam (4).

10 Install three cup point setscrews (3).

11 Install three flat setscrews (1).

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY

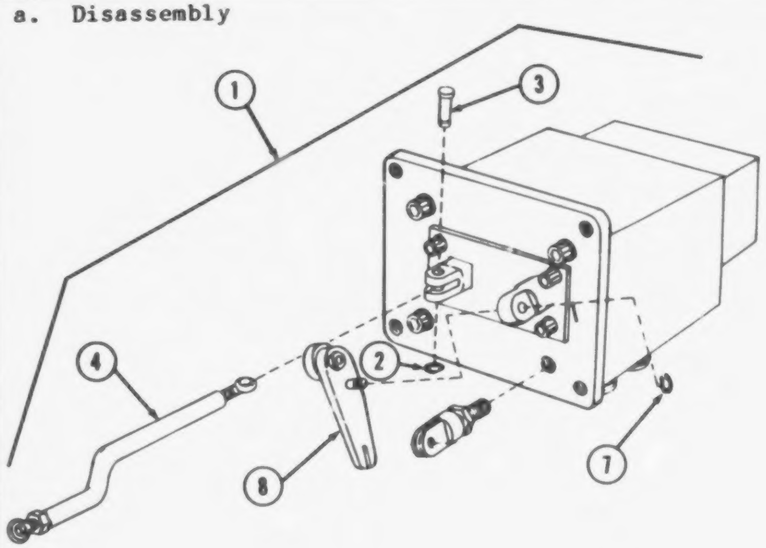
This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts

Preformed packings
Hydraulic fluid (Item 10, App. C)
Lock washers

a. Disassembly



NOTE

The following procedures apply to both gunner's and assistant gunner's control body assemblies.

1 Remove gunner's and assistant gunner's control assemblies and gunner's and assistant gunner's control assembly handles (ref. pages 5-156, 5-163 and 5-186).

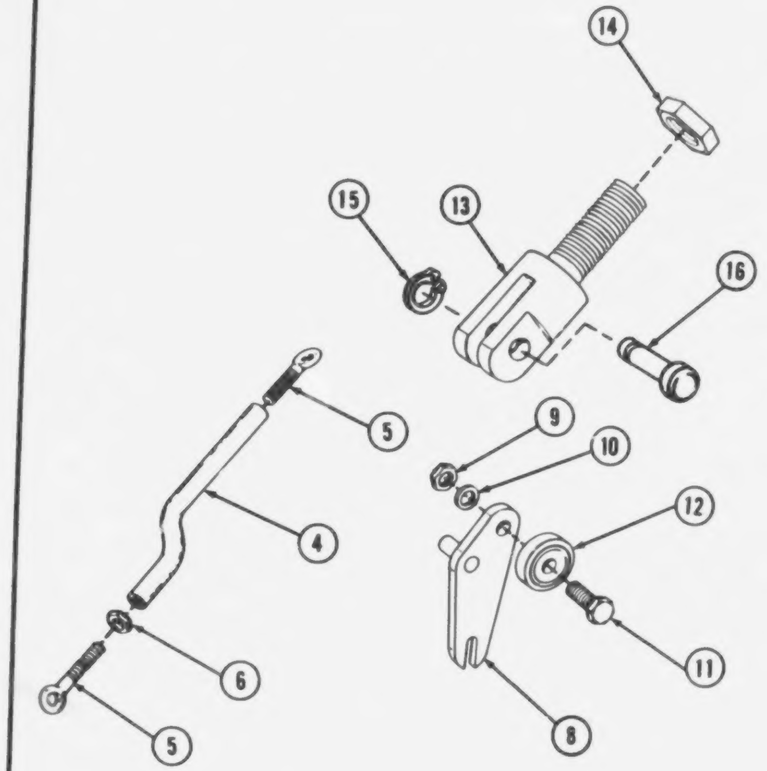
2 Remove bracket, cam and housing group (ref. page 5-187).

3 Place control body assembly (1) on a solid flat work surface.

4 Remove retaining ring (2), grooved headed pin (3) and gun control rod (4).

5 Unscrew two eye bolts (5) from each end of gun control rod (4).

6 Remove plain hex nut (6) from one eye bolt (5).



7 Remove retaining ring (7).

8 Disengage and remove arm (8).

9 Remove plain hex nut (9), lock washer (10), machine bolt (11) and ball bearing (12) from arm (8). Discard lock washer (10).

10 Unscrew and remove clevis (13).

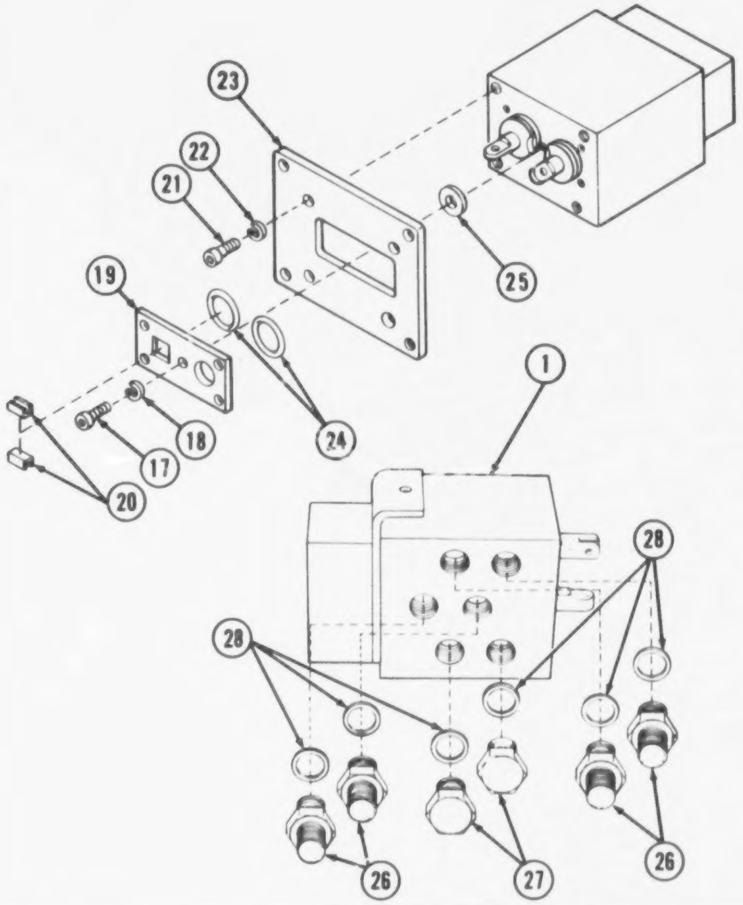
11 Remove plain hex nut (14) from clevis (13).

12 Remove retaining ring (15) and grooved headed pin (16) from clevis (13).

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY — Continued

a. Disassembly-Continued



13 Remove five socket head cap screws (17), five lock washers (18) and cover plate (19). Discard five lock washers (18).

14 Remove two guides (20) from cover plate (19).

15 Remove three socket head cap screws (21), three lock washers (22) and plate (23). Discard three lock washers (22).

16 Remove two retaining rings (24).

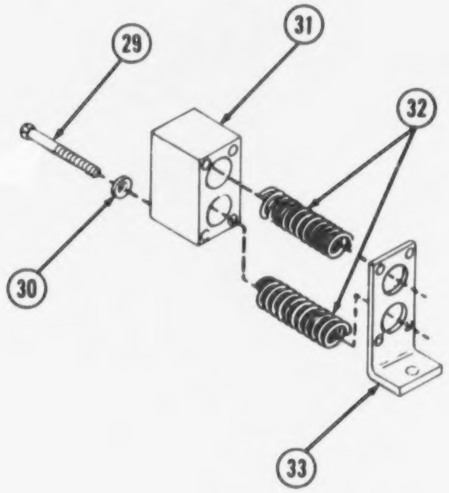
17 Remove flat washer (25).

NOTE

Gunner's control assembly will have six adapters. Assistant gunner's control assembly will have four adapters and two plugs. Assistant gunner's control assembly is shown in illustration.

18 Remove six adapters (26) or four adapters (26) and two plugs (27) from control body assembly (1).

19 Remove and discard six preformed packings (28).



WARNING

Restrain control body cover while removing screws. Cover holds two springs in compression.

20 Remove four socket head cap screws (29), four lock washers (30) and control body cover (31). Discard four lock washers (30).

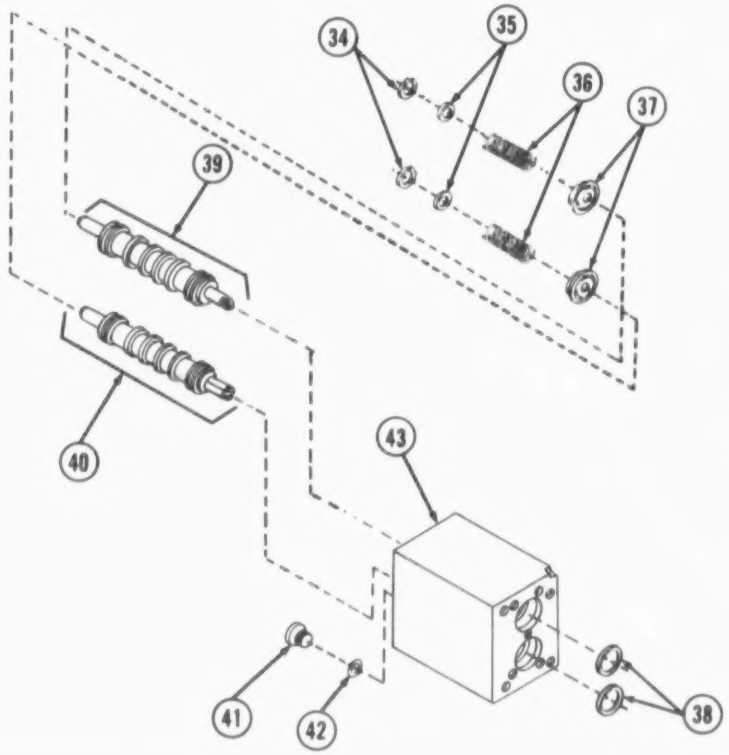
21 Remove two springs (32).

22 Remove support (33).

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY – Continued

a. Disassembly-Continued



WARNING

Retaining rings and retainers hold the small centering springs in compression. Restrain retainer as retaining ring is removed.

23 Remove two retaining rings (34).

24 Remove two retainers (35).

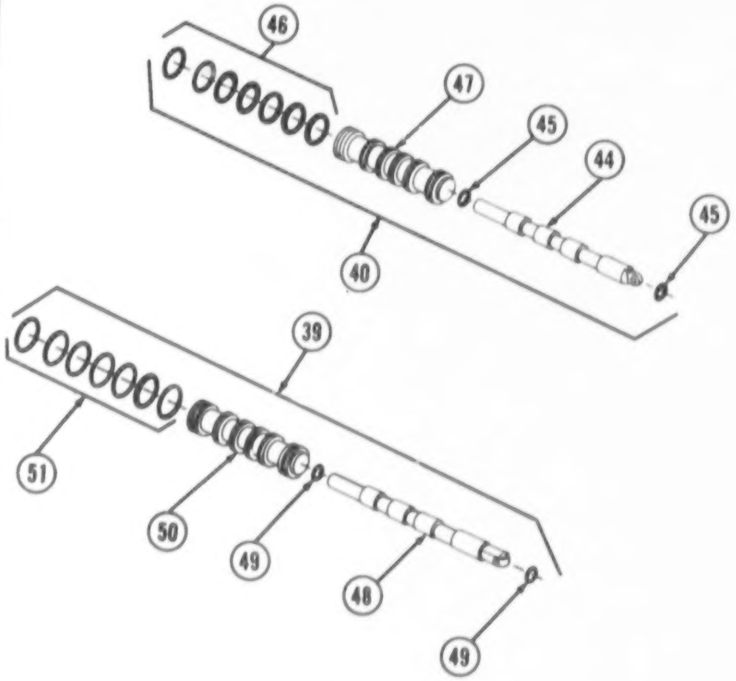
25 Remove two centering springs (36).

26 Remove two spring stops (37).

27 Remove two retaining rings (38).

28 Withdraw traversing sleeve and slide group (39) out of front end of body (43).

29 Remove elevating sleeve and slide group (40), plug (41) and preformed packing (42). Discard preformed packing (42).



30 Withdraw elevating spool (44) from elevating sleeve and slide group (40).

31 Remove and discard two preformed packings (45) from elevating spool (44).

32 Remove and discard seven preformed packings (46) from elevating sleeve (47).

33 Withdraw traversing spool (48) from traversing sleeve and slide group (39).

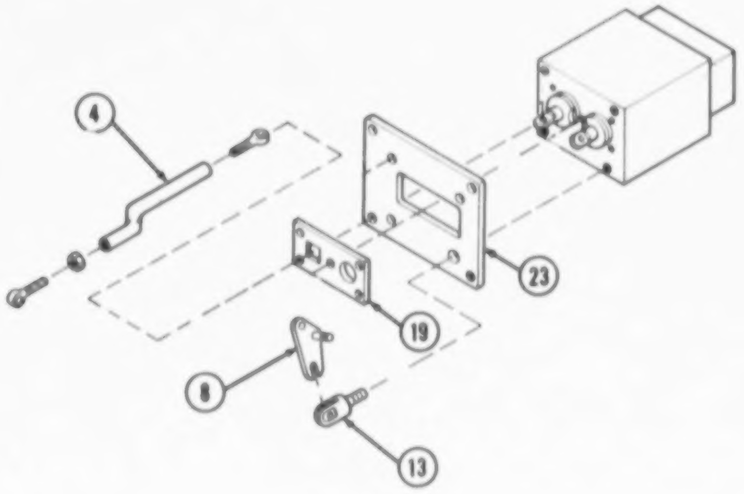
34 Remove and discard two preformed packings (49) from traversing spool (48).

35 Remove and discard seven preformed packings (51) from traversing sleeve (50).

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY — Continued

b. Inspection



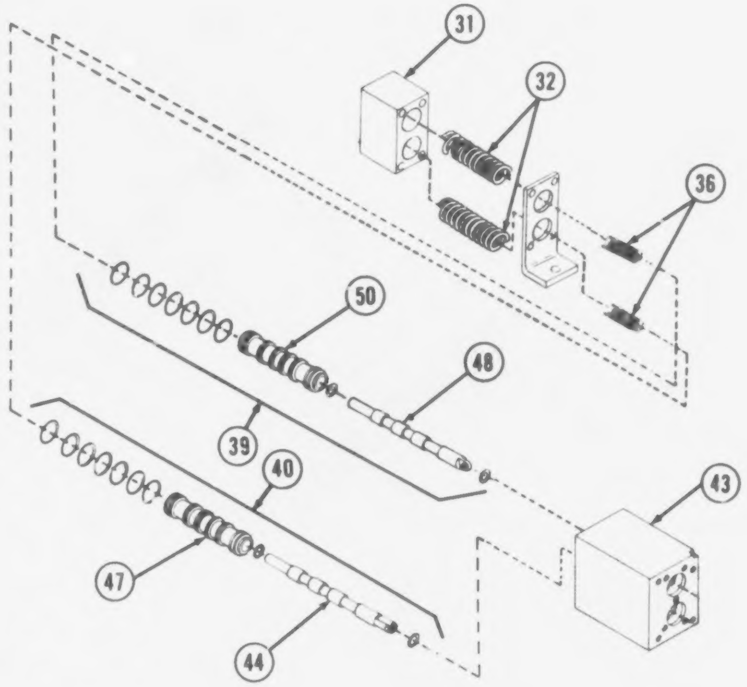
1 Inspect gun control rod (4). Replace if bent, distorted or damaged.

2 Inspect arm (8). Replace if bent, distorted or damaged.

3 Inspect clevis (13). Replace if bent or threads are damaged.

4 Inspect cover plate (19). Replace if it does not fit flat on plate (23).

5 Inspect plate (23). Replace if cracked or warped.



6 Inspect control body cover (31) and body (43). Replace if cracked, distorted or damaged.

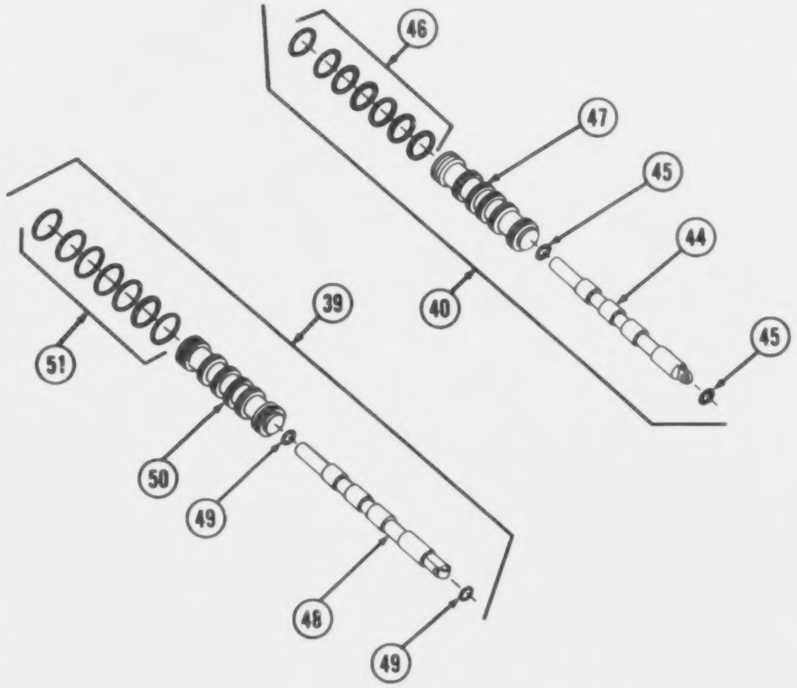
7 Inspect two springs (32) and two centering springs (36). Replace if cracked, fatigued or scratched.

8 Traversing and elevating sleeve and slide groups (39 and 40) are matched fits. If outside of traversing and elevating spools (48) and (44) or inside surface of traversing and elevating sleeves (50) and (47) are scratched or scored, replace that assembly.

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY — Continued

c. Assembly



NOTE

Coat spools, sleeves and preformed packings with hydraulic fluid (Item 11, App. C) before assembling. Install preformed packings without distorting them and avoid damage when assembling sleeves to bore. Avoid contaminating finished surfaces.

1 Install seven new preformed packings (51) on traversing sleeve (50).

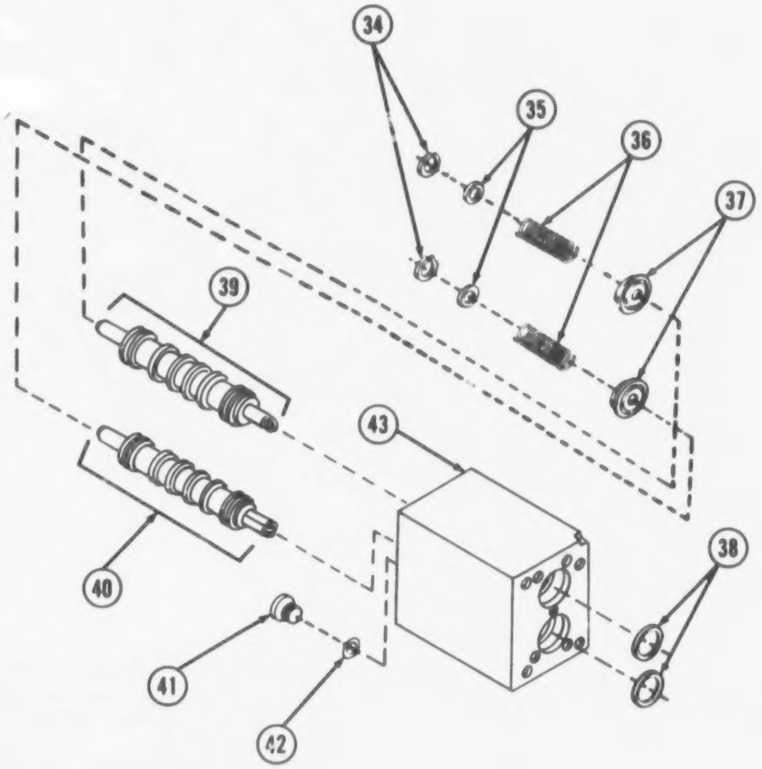
2 Install two new preformed packings (49) on traversing spool (48).

3 Insert traversing spool (48) into traversing sleeve and slide group (39).

4 Install seven new preformed packings (46) on elevating sleeve (47).

5 Install two new preformed packings (45) on elevating spool (44).

6 Insert elevating spool (44) into elevating sleeve and slide group (40).



7 Install new preformed packing (42), plug (41) and elevating sleeve and slide group (40).

8 Insert traversing sleeve and slide group (39) into front end of body (43).

WARNING

Retaining rings and retainers hold the small centering springs in compression. Restrain retainer as retaining ring is installed.

9 Install two retaining rings (38).

10 Install two spring stops (37).

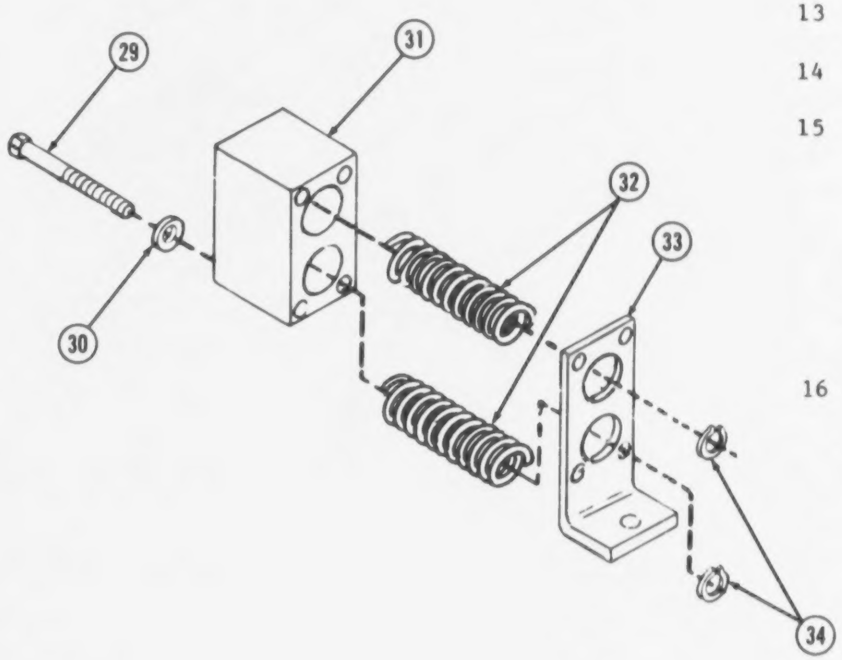
11 Install two centering springs (36).

12 Install two retainers (35).

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY — Continued

c. Assembly-Continued



13 Install two retaining rings (34).

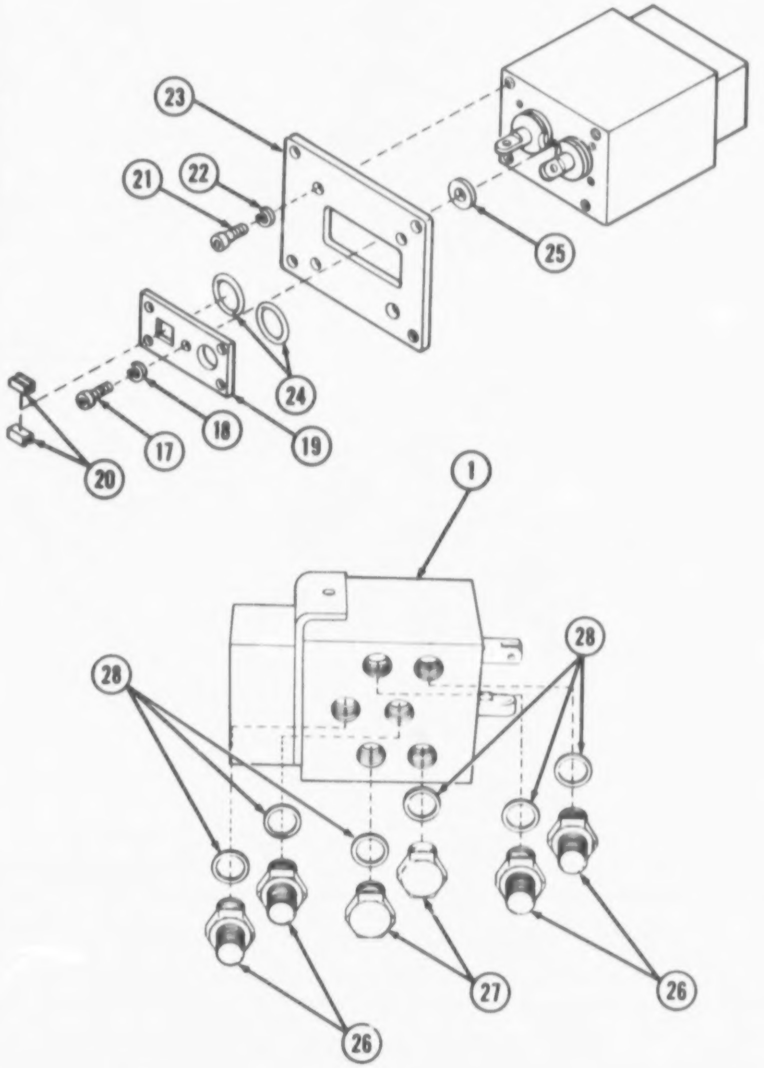
14 Install support (33).

15 Install two springs (32).

WARNING

Restrain control body cover while installing screws. Control body cover holds two springs in compression.

16 Install control body cover (31), four new lock washers (30) and four socket head cap screws (29).



17 Install six new preformed packings (28).

NOTE

Gunner's control assembly will have six adapters. Assistant gunner's control assembly will have four adapters and two plugs. Assistant gunner's control assembly is shown in illustration.

18 Install six adapters (26) or four adapters (26) and two plugs (27) in control body assembly (1).

19 Install flat washer (25).

20 Install two retaining rings (24).

21 Install plate (23), three new lock washers (22) and three socket head cap screws (21).

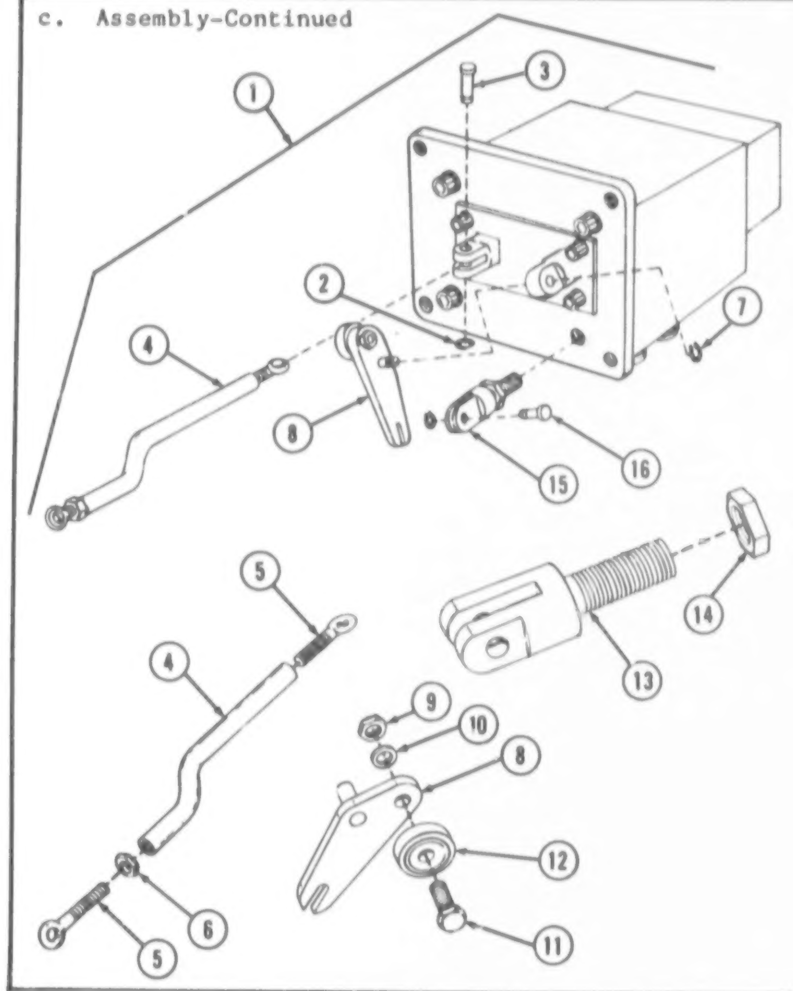
22 Install two guides (20) on cover plate (19).

23 Install cover plate (19), five new lock washers (18) and five socket head cap screws (17). Torque five socket head cap screws (17) to 30-35 in-lb (3.4-4 N·m).

CAB HYDRAULICS — Continued

5-24. CONTROL ASSEMBLY — Continued

c. Assembly-Continued



24 Install retaining ring (15) and grooved headed pin (16) on clevis (13).

25 Install plain hex nut (14) on clevis (13).

26 Screw clevis (13) into control body assembly (1).

27 Install ball bearing (12), machine bolt (11), new lock washer (10) and plain hex nut (9) on arm (8).

28 Install arm (8).

29 Install retaining ring (7).

30 Install plain hex nut (6) on one eyebolt (5).

31 Screw one eye bolt (5) into each end of gun control rod (4).

32 Install gun control rod (4), grooved headed pin (3) and retaining ring (2).

33 Install bracket, cam and housing group (ref. page 5-194).

34 Install gunner's and assistant gunner's control assemblies and gunner's and assistant gunner's control assembly handles (ref. pages 5-160, 5-165 and 5-187).

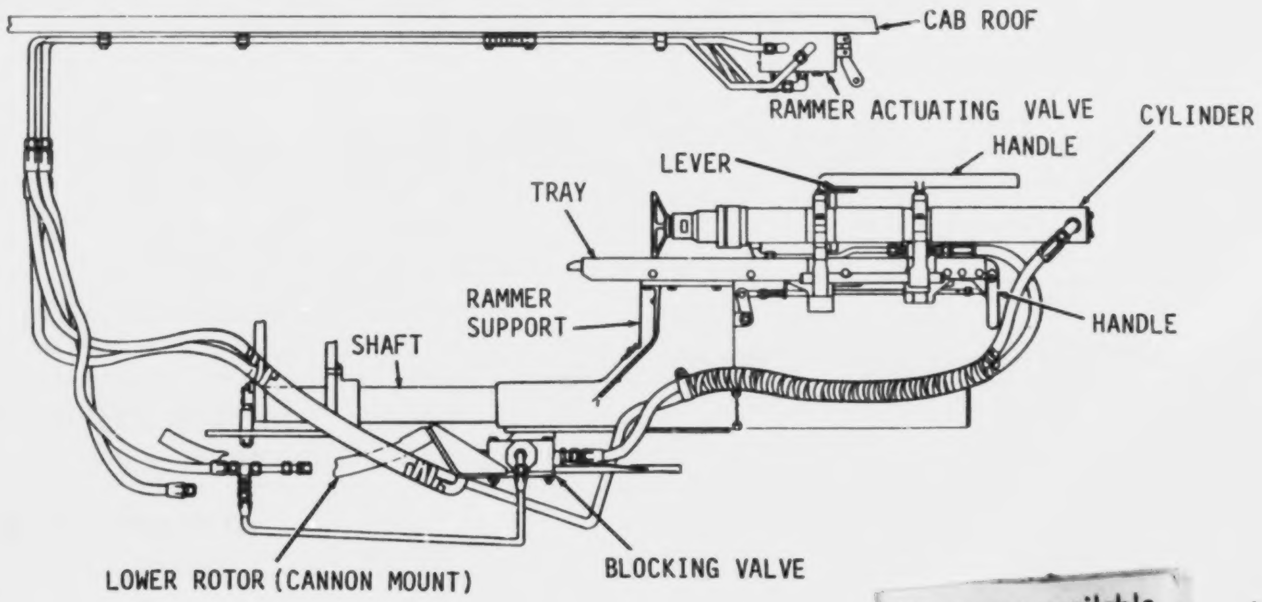
CHAPTER 6 RAMMER SYSTEM

GENERAL

This chapter illustrates and describes maintenance of the weapon-mounted projectile rammer. The rammer is a hydraulically-powered device which is controlled by a hand-operated rammer actuating valve. No electrical circuits are used in the system. A second valve in the system, the blocking valve, prevents rammer from being operated unless it is correctly alined with the chamber.

The rammer system is illustrated below.

Title		Page
6-1.	RAMMER LINES AND FITTINGS	6-2
6-2.	RAMMER ASSEMBLY	6-4
6-3.	CYLINDER ASSEMBLY	6-24
6-4.	RAMMER ACTUATING VALVE ASSEMBLY	6-34



CAB ROOF
RAMMER ACTUATING VALVE
CYLINDER
HANDLE
LEVER
TRAY
RAMMER SUPPORT
SHAFT
HANDLE
LOWER ROTOR (CANNON MOUNT)
BLOCKING VALVE

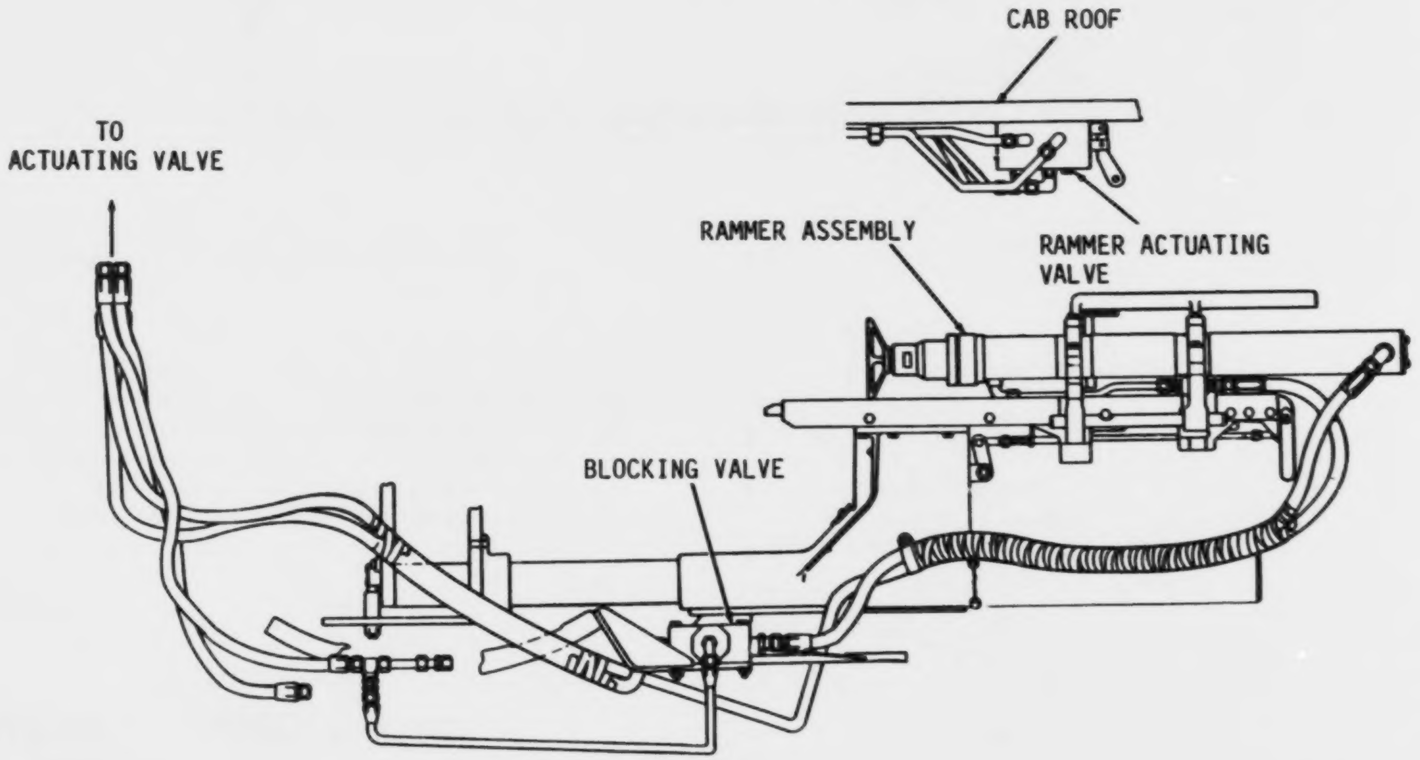
best copy available

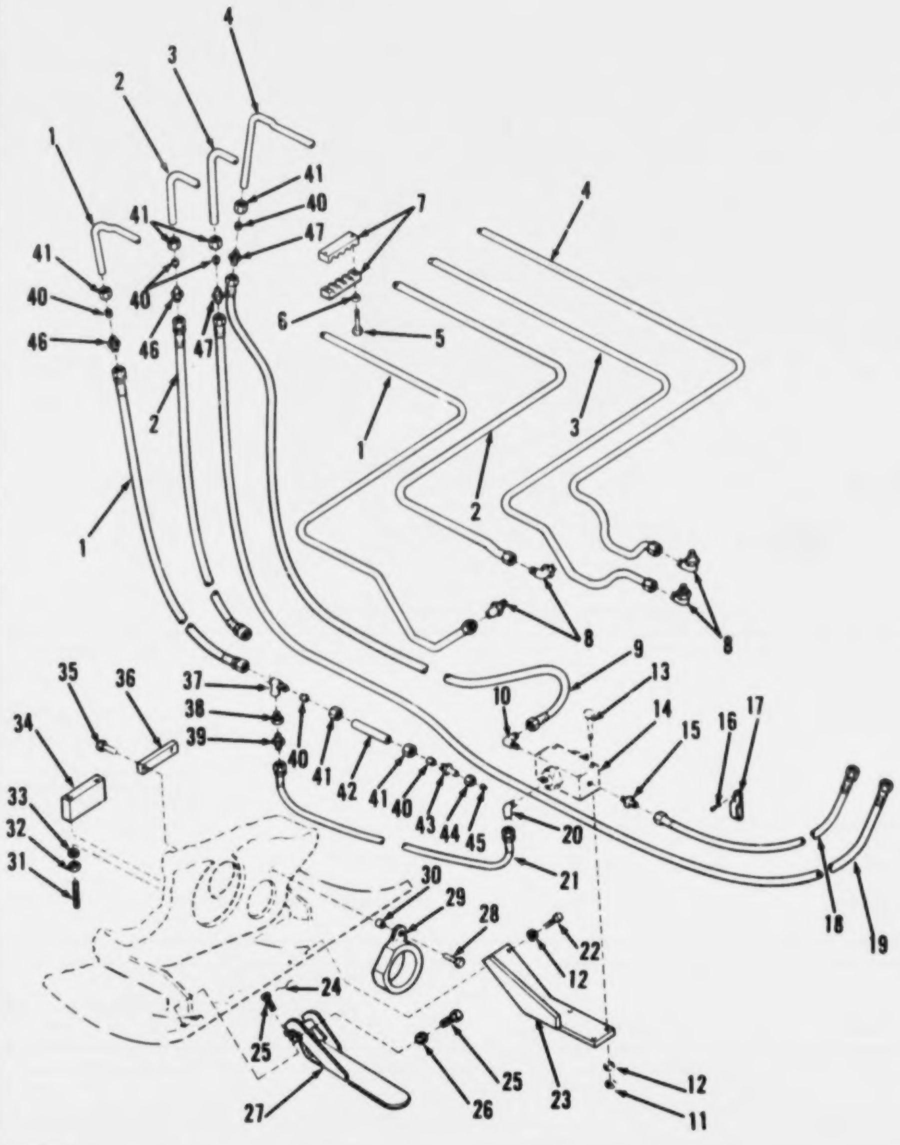
RAMMER SYSTEM — Continued

6-1. RAMMER LINES AND FITTINGS

This task covers: Removal and Installation

Removal and Installation


CAB ROOF
TO
ACTUATING VALVE
RAMMER ASSEMBLY
RAMMER ACTUATING
VALVE
BLOCKING VALVE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Follow illustration as a guide.

Legend

1. Tube
2. Tube
3. Tube
4. Tube
5. Hex head cap screw (10)
6. Flat washer (10)
7. Bracket (10)
8. Elbow (4)
9. Hose assembly
10. Elbow
11. Hex nut (4)
12. Lock washer (6)
13. Hex head cap screw (4)
14. Blocking valve
15. Adapter
16. Machine screw
17. Clamp
18. Hose assembly
19. Hose assembly
20. Elbow
21. Hose assembly
22. Hex head cap screw (2)
23. Bracket
24. Lock wire
25. Hex head cap screw (4)
26. Hex nut (2)
27. Bracket
28. Hex head cap screw (3)
29. Bumper
30. Spacer
31. Setscrew (2)
32. Hex nut (2)
33. Flat washer (2)
34. Positioning block
35. Hex head cap screw (2)
36. Retaining plate
37. Tee
38. Pipe bushing
39. Adapter
40. Sleeve (6)
41. Coupling nut (6)
42. Hollow pin
43. Straight adapter
44. Coupling nut (6)
45. Sleeve (6)
46. Tube nipple
47. Adapter (2)

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation f. Adjustment

INITIAL SET-UP

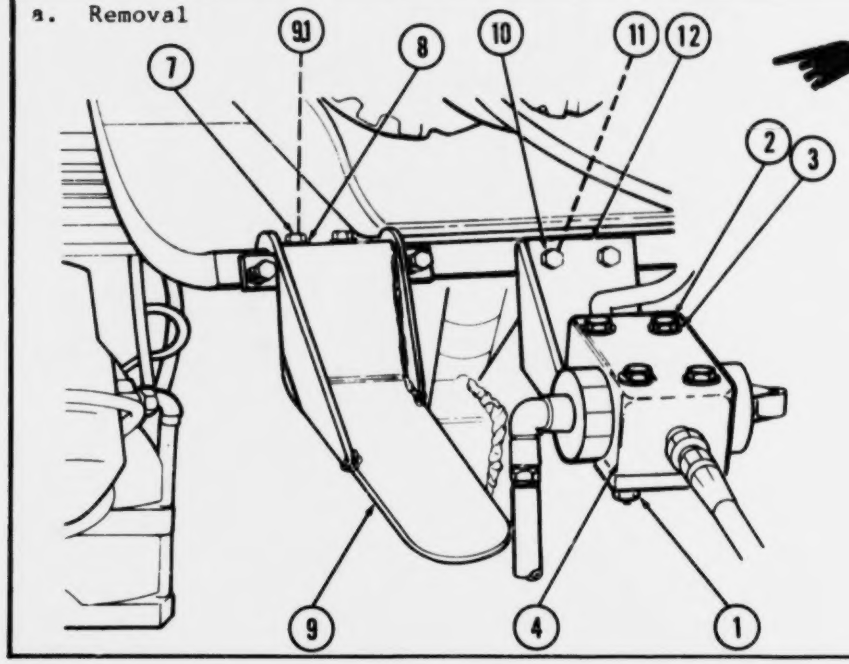
Materials/Parts

Cover gasket
Lock wire
Sealing compound (Item 19, App. C)
Lock washers
Cotter pin
Antiseizing compound (Item 5.1, App. C)

Personnel Required

2

a. Removal

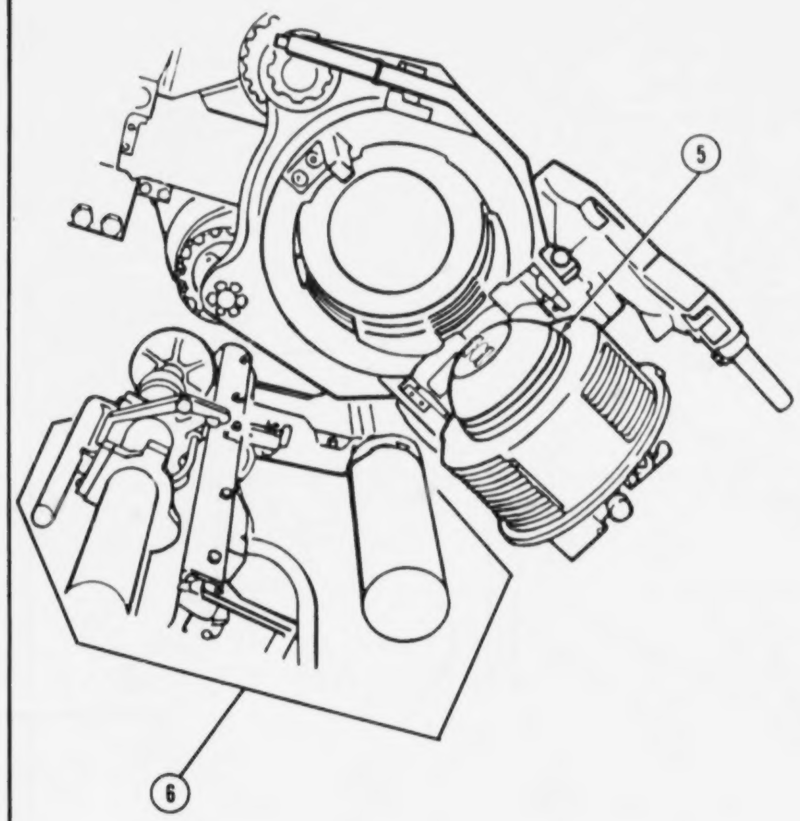


1 Set cannon at 0° elevation.

2 Discharge and drain hydraulic system (ref. TM 9-2350-311-20-2).

3 Remove rammer lines and fittings (ref. page 6-2).

4 Remove four nuts (1), four screws (2), four lock washers (3) and blocking valve (4). Discard four lock washers (3).



5 Open breechblock (5).

6 Move rammer assembly (6) to ram position.

7 Remove lock wire and two screws (7), two washers (8) and rammer support bracket (9). Discard lock wire (7).

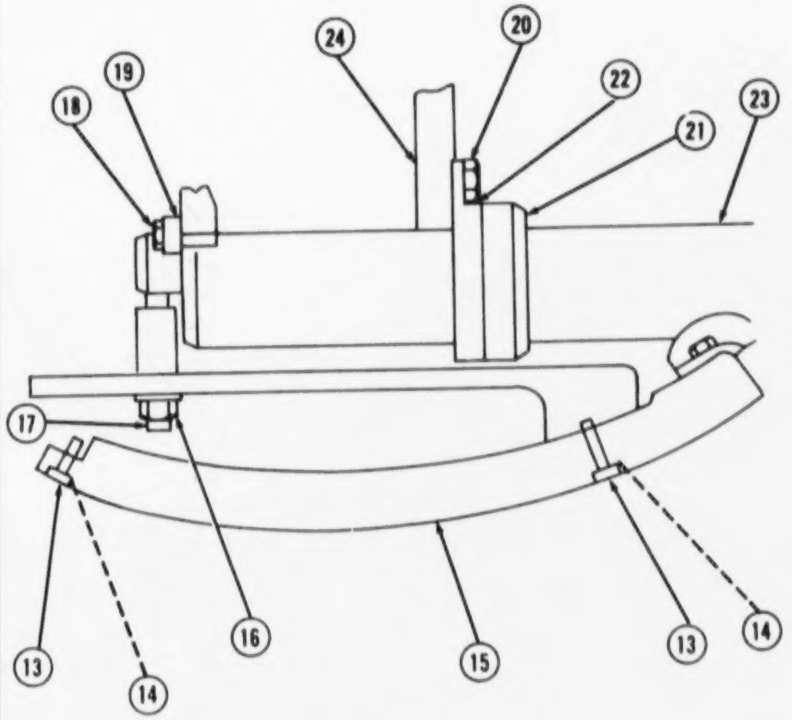
7.1 **Remove two inserts (9.1) if threads are cracked or stripped. Discard inserts.**

8 Remove two screws (10), two lock washers (11) and valve support bracket (12). Discard two lock washers (11).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

a. Removal-Continued



WARNING

Weight of lower rotor shield is approximately 57 pounds (26 kilograms). Two persons are required for removal and installation. Lower rotor shield must be supported during removal and installation.

9 Remove eight screws (13), eight lock washers (14) and lower rotor shield (15). Discard eight lock washers (14).

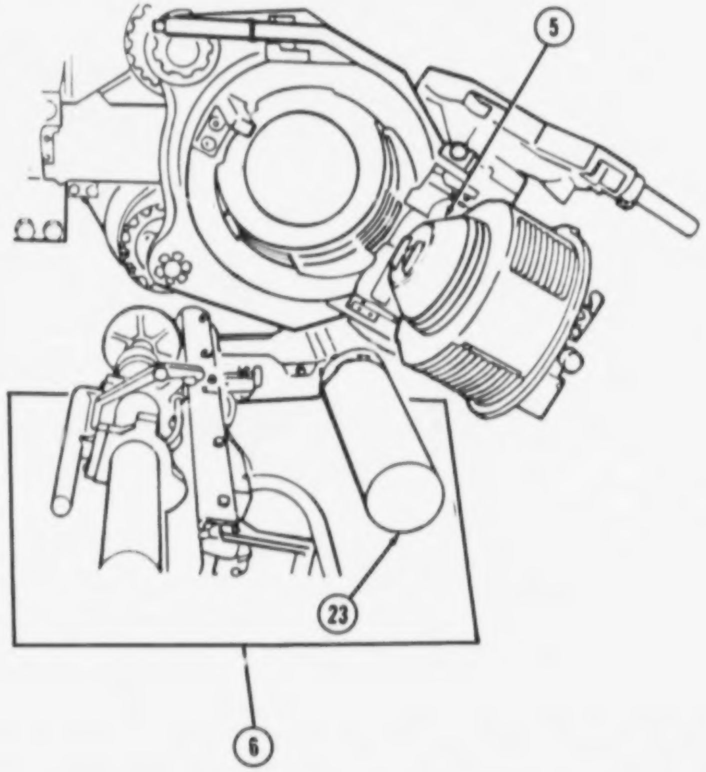
10 Loosen two jam nuts (16) and two shaft adjusting socket head cap screws (17).

11 Remove two screws (18) and locking plate (19).

NOTE

When rammer has been removed to facilitate tray removal of cannon, replace lower rotor shield and stow rammer with hoses attached on cab floor directly beneath cannon mount.

12 Remove screw (20) from front bumper (21) and spacer (22).



WARNING

Weight of rammer and shaft assembly is approximately 198 pounds (90 kilograms). Two persons are required for removal and installation.

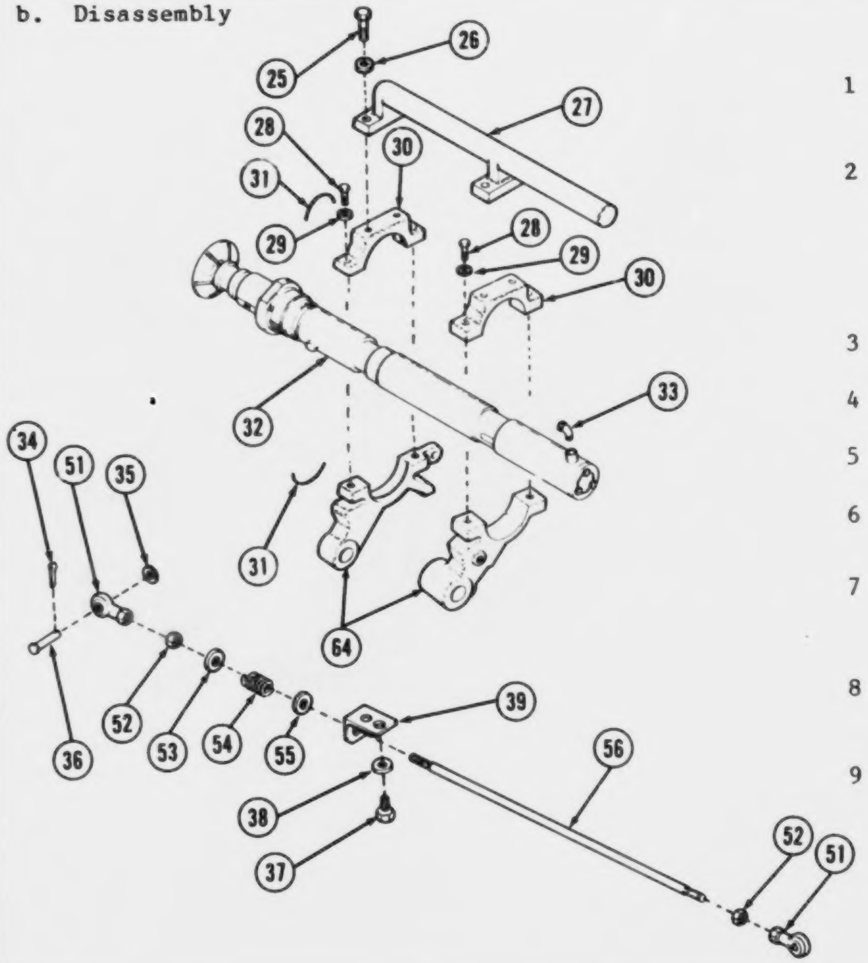
13 Slide rammer assembly (6) with front bumper (21) and spacer (22) out of mount (24) on shaft (23).

14 Close breechblock (5).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

b. Disassembly



1 Remove four screws (25), four washers (26) and handle (27).

2 Remove four screws (28), four washers (29) and two caps (30). Identify each cap (30) with its cylinder support (64). Two caps (30) and front and rear cylinder supports (64) are matched sets.

3 Remove upper half of lock ring (31).

4 Remove cylinder assembly (32).

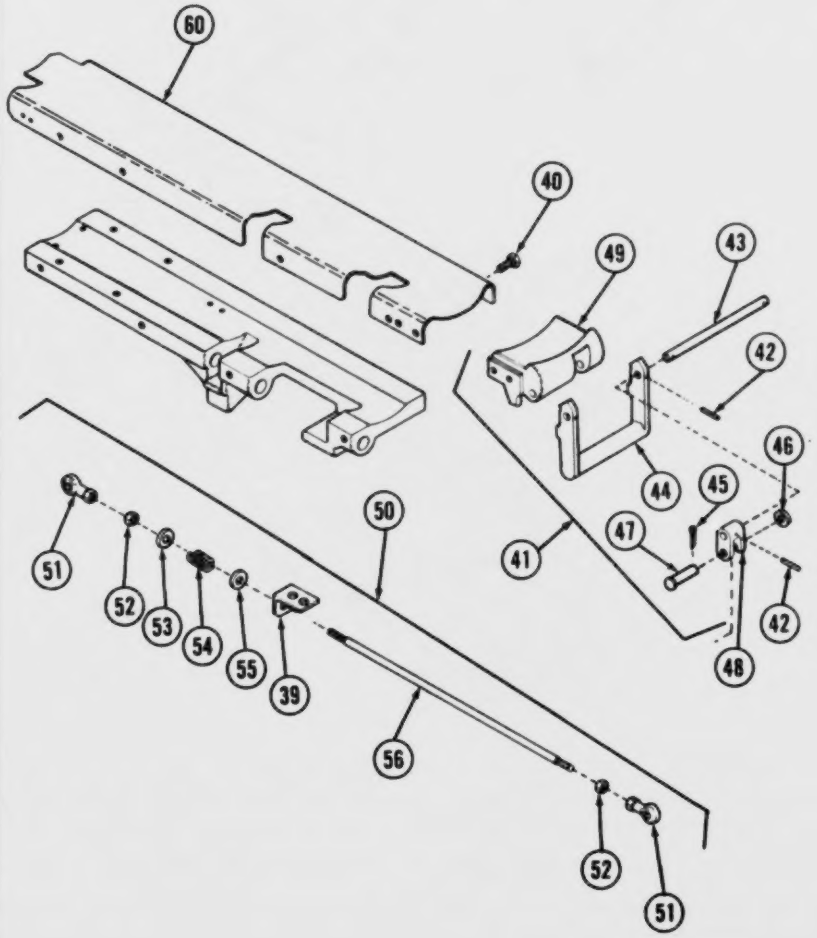
5 Remove lower half of lock ring (31).

6 Remove elbow (33) from cylinder assembly (32).

7 Remove cotter pin (34) and washer (35) from straight headed pin (36). Discard cotter pin (34).

8 Withdraw straight headed pin (36) from spherical rod end bearing (51).

9 Remove two screws (37) and two washers (38) from bracket (39).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10 Remove four screws (40) and handle group (41) from tray (60).

11 Remove two spring pins (42), straight headless pin (43) and handle (44) from handle support (49).

12 Remove cotter pin (45), washer (46), straight-headed pin (47) and lever (48) from handle support (49). Discard cotter pin (45).

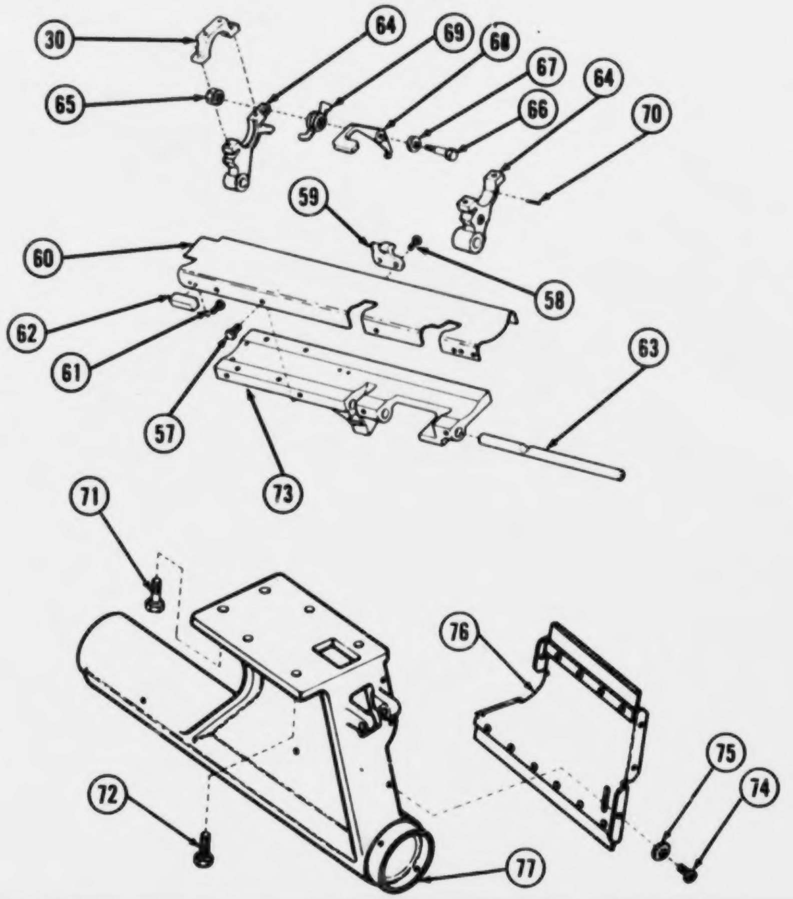
13 Remove rod group (50).

14 Remove two spherical rod end bearings (51), two hex nuts (52), washer (53), spring (54), washer (55) and bracket (39) from rod (56).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

b. Disassembly-Continued



15 Remove five screws (57), two screws (58), latch (59) and tray (60).

16 Remove two screws (61) and block (62) from tray (60).

17 Remove straight headless pin (63). A 0.25 inch (6.4 mm) threaded hole in end of straight headless pin (63) can be used to install a pulling device to remove straight headless pin (63).

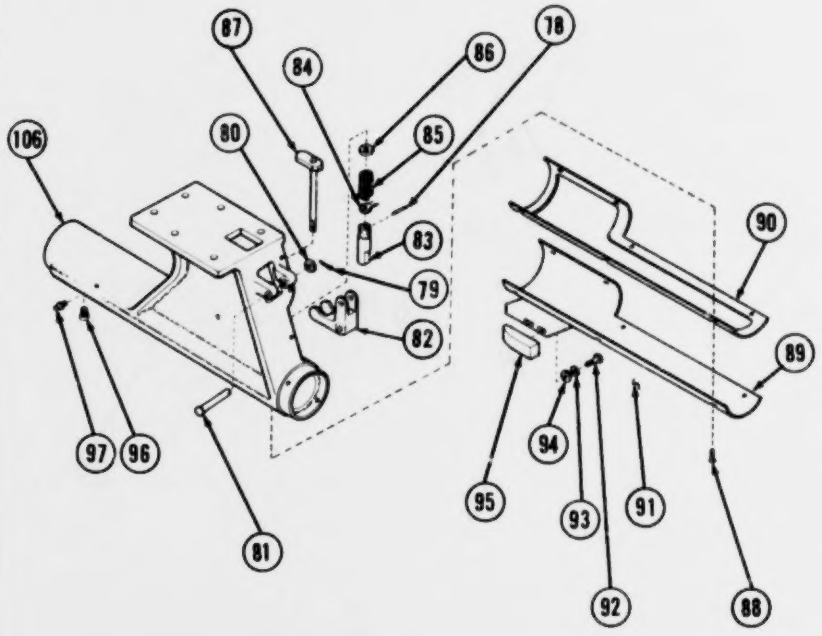
18 Remove two front and rear cylinder supports (64) and retain together with two caps (30) (ref. step 2, Disassembly). Front and rear cylinder supports (64) and two caps (30) are matched sets.

19 Remove nut (65), bolt (66), washer (67), lever (68) and helical spring (69) from front cylinder support (64).

20 Remove machine key (70) from rear cylinder support (64).

21 Remove two screws (71), four screws (72) and tray support (73) from flange of rammer support group (77).

22 Remove five screws (74), five flat washers (75) and cover (76) from rammer support group (77).



23 Remove spring pin (78).

24 Remove cotter pin (79), washer (80), straight-headed pin (81), and lock pin actuating lever (82). Discard cotter pin (79).

25 Remove shaft lock pin (83), position pointer (84), helical spring (85), flat washer (86) and actuator (87).

26 Remove seven screws (88), cover (89) and cover gasket (90) from rammer support (106). Discard cover gasket (90).

27 Remove lock wire (91), two screws (92), two lock washers (93), two flat washers (94) and ramp (95) from cover (89). Discard lock wire (91). Discard two lock washers (93).

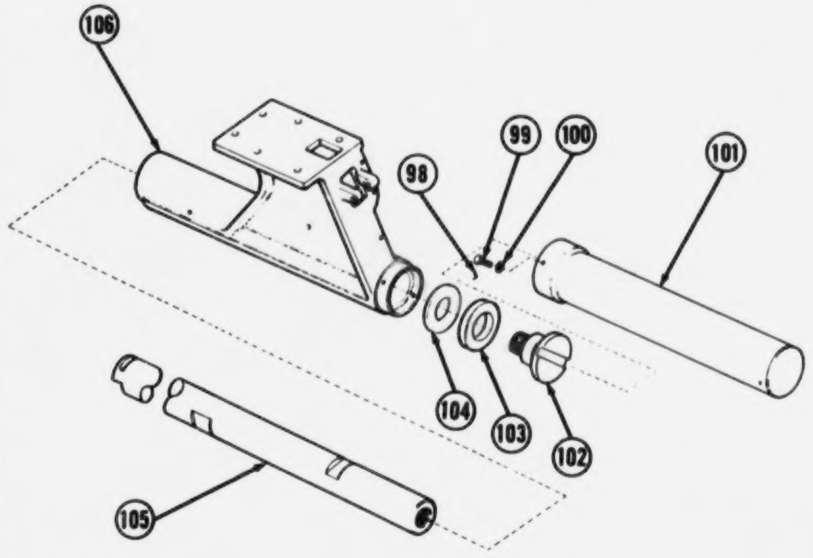
28 Remove guide (96).

29 Remove two lubrication fittings (97).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

b. Disassembly-Continued

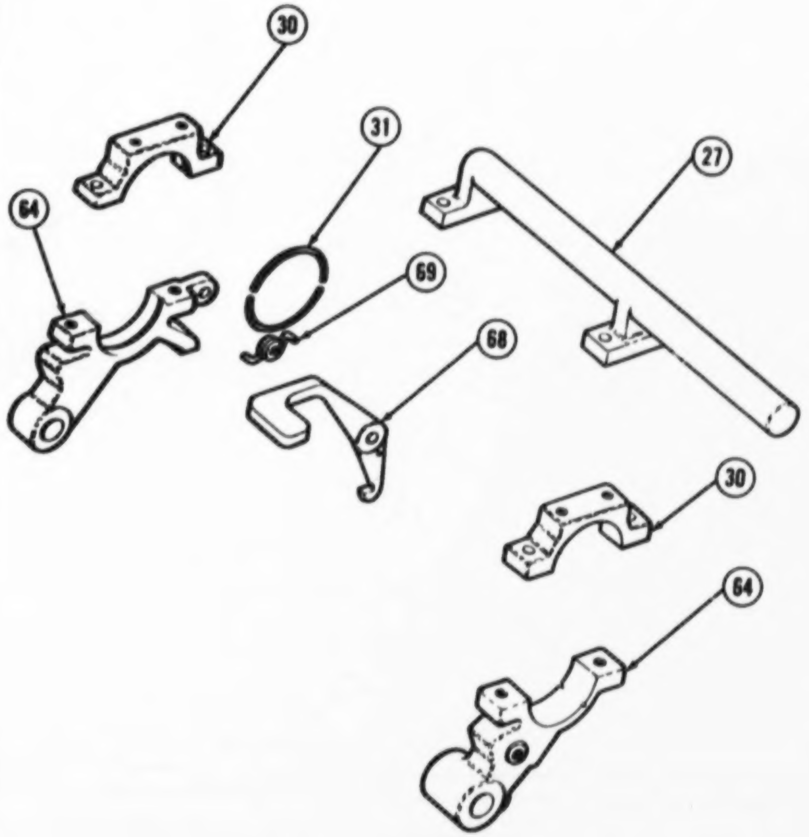


30 Remove lock wire (98), four screws (99), four washers (100) and shaft cover (101) from rear of rammer support (106). Discard lock wire (98).

31 Remove retainer (102), rubber bumper (103) and bumper washer (104).

32 Remove shaft (105) from rammer support (106).

c. Inspection and Repair



1 Inspect handle (27). Replace if cracked, broken or distorted.

2 Inspect lever (68). Replace if cracked or severely worn.

3 Inspect helical spring (69). Replace if distorted or cracked .

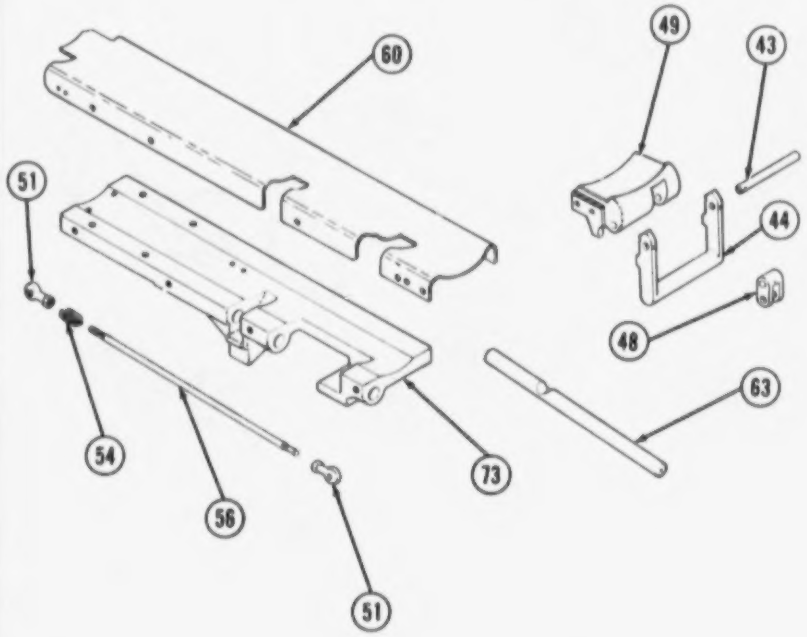
4 Inspect lock ring (31). Replace if distorted or cracked. Remove burrs or sharp edges with crocus cloth.

5 Inspect matched sets of front and rear cylinder supports (64) and caps (30). Remove burrs with crocus cloth. Chase threads if damaged. Replace as matched sets if cracked or distorted.

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

c. Inspection and Repair-Continued



6 Inspect tray (60). Replace if cracked, broken or distorted.

7 Inspect straight headless pin (63) for burrs or other damage. Replace if cracked or distorted.

8 Inspect tray support (73). Replace if cracked, broken or distorted. Remove burrs with crocus cloth. Chase damaged threads.

9 Inspect handle support (49). Replace if cracked, broken or distorted. Remove burrs with crocus cloth. Chase damaged threads.

10 Inspect straight headless pin (43). Replace if bent, cracked or distorted.

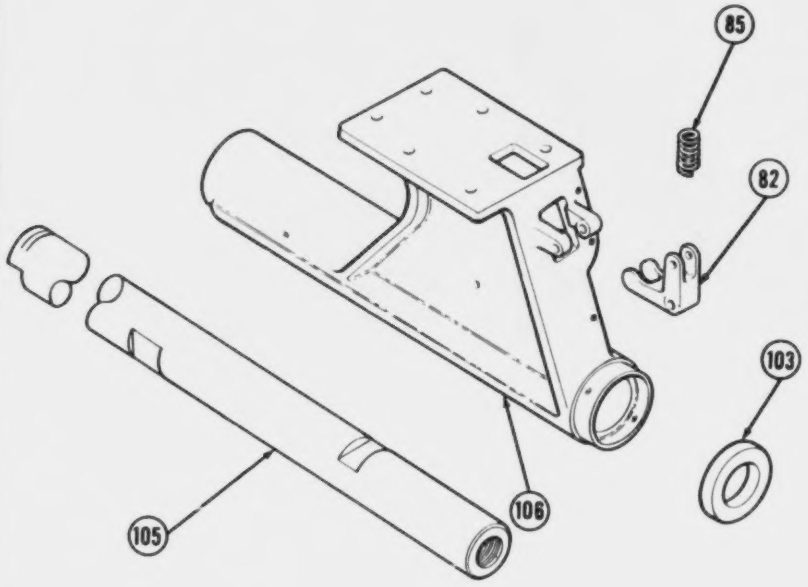
11 Inspect lever (48) for cracks, burrs or visible distortion. Replace if cracked, burred or distorted.

12 Inspect handle (44). Replace if cracked, broken or distorted.

13 Inspect and rotate two spherical rod end bearings (51). Bearings must rotate freely. Replace if cracked or corroded.

14 Inspect rod (56). Replace if bent or distorted.

15 Inspect spring (54). Replace if distorted, cracked or nicked.



16 Inspect helical spring (85). Replace if cracked or distorted .

17 Inspect lock pin actuating lever (82). Replace if cracked or severely worn.

18 Inspect rammer support (106) for burrs, cracks or visible damage. Remove burrs. Replace if cracked or damaged. Chase damaged threads.

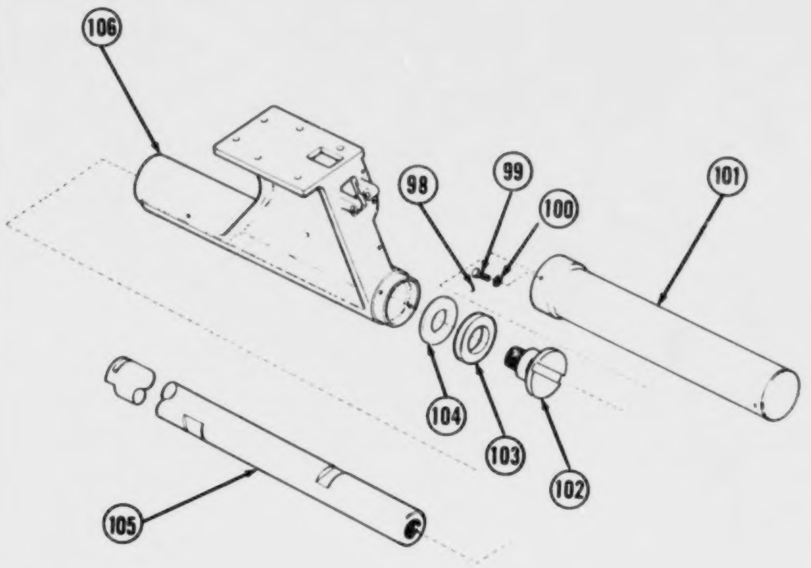
19 Inspect rubber bumper (103). Replace if brittle, cracked or distorted.

20 Inspect shaft (105) for burrs, wear or damaged threads. Remove burrs. Replace if cracked or damaged. Chase damaged threads.

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY – Continued

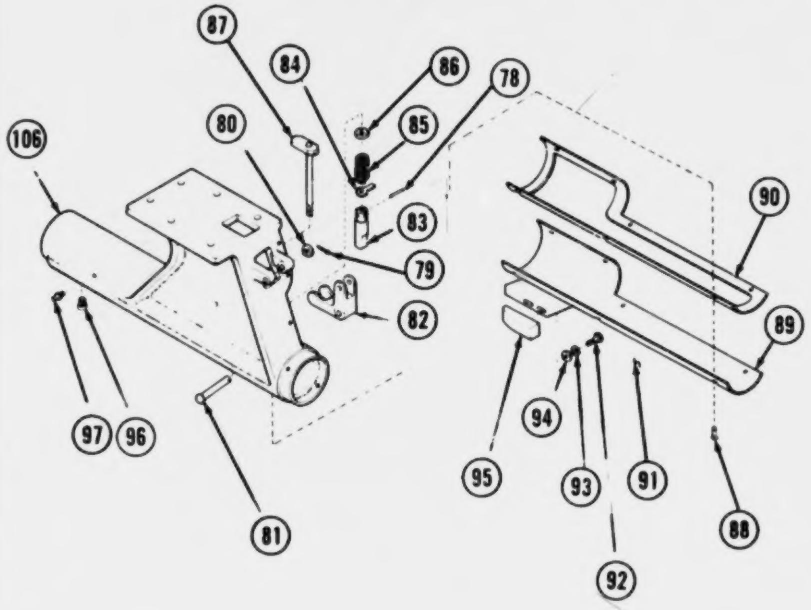
d. Assembly

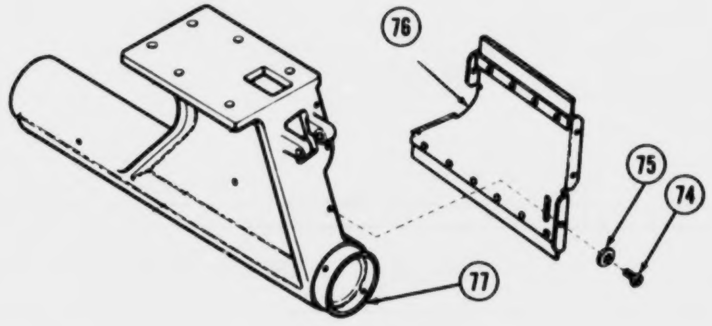


1 Install shaft (105) on rammer support (106).

2 Install bumper washer (104), rubber bumper (103) and retainer (102).

3 Install shaft cover (101), four washers (100) and four screws (99) on rear of rammer support (106). Secure four screws (99) with new lock wire (98).





4 Install two lubrication fittings (97).

5 Install guide (96).

6 Install ramp (95), two flat washers (94), two new lock washers (93) and two screws (92) on cover (89). Secure two screws (92) with new lock wire (91).

7 Install new cover gasket (90), cover (89) and seven screws (88) on rammer support (106).

8 Install actuator (87), flat washer (86), helical spring (85), position pointer (84) and shaft lock pin (83).

9 Install lock pin actuating lever (82), straight-headed pin (81), washer (80) and new cotter pin (79).

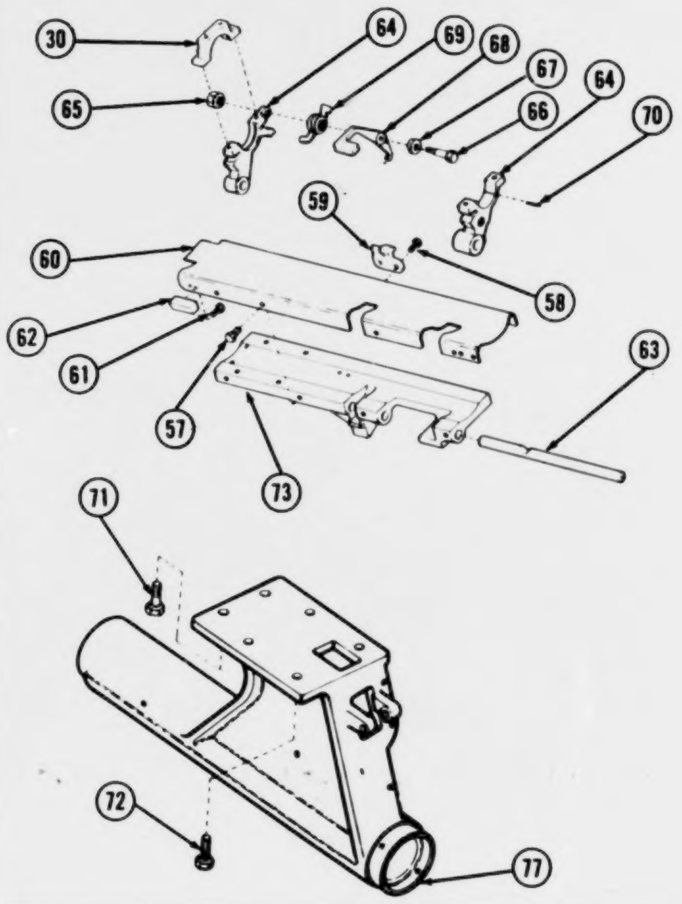
10 Install spring pin (78).

11 Install cover (76), five flat washers (75) and five screws (74) to rammer support group (77).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

d. Assembly-Continued



12 Apply sealing compound (Item 19, App. C) to threads of four screws (72) and two screws (71). Install tray support (73), four screws (72) and two screws (71) to flange of rammer support group (77). Torque two screws (71) and four screws (72) to 32-39 lb-ft (43-53 N·m).

13 Install machine key (70) in rear cylinder support (64).

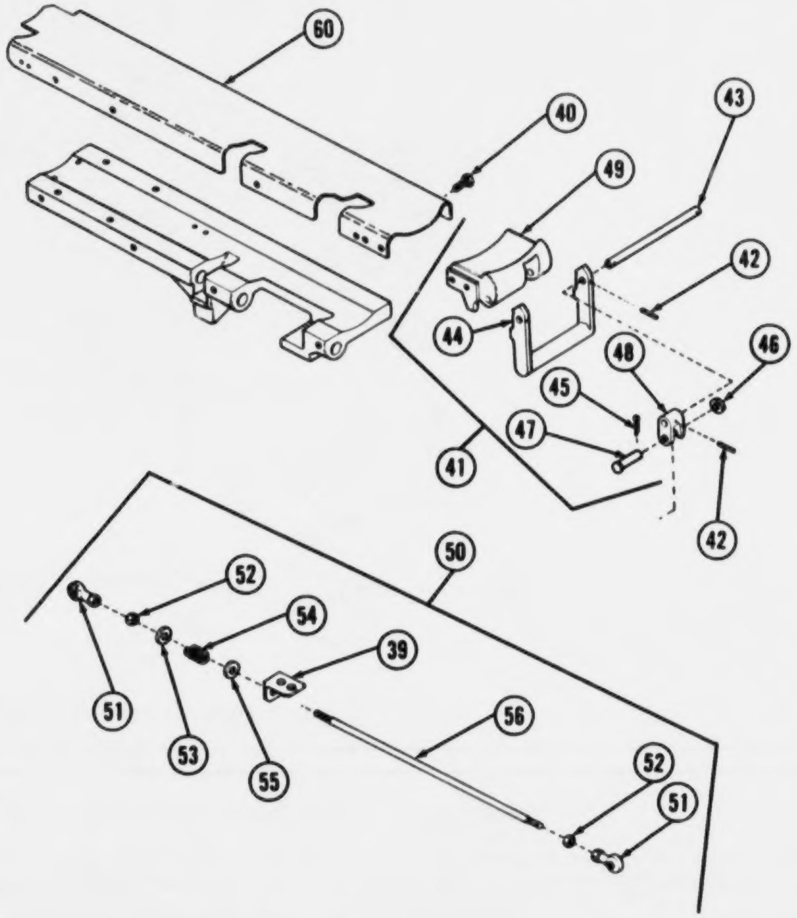
14 Apply sealing compound (Item 19, App. C) to threads of nut (65) and bolt (66). Install helical spring (69), lever (68), washer (67), bolt (66) and nut (65) to front cylinder support (64). Torque bolt (66) to 34-42 lb-ft (46-57 N·m).

15 Install front and rear cylinder supports (64) and caps (30). (Front and rear cylinder supports (64) and caps (30) are matched sets).

16 Install straight headless pin (63).

17 Install block (62) and two screws (61) to tray (60).

18 Apply sealing compound (Item 19, App. C) to threads of five screws (57). Install tray (60), latch (59), two screws (58) and five screws (57). Torque five screws (57) to 32-39 lb-ft (43-53 N·m).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19 Install bracket (39), washer (55), spring (54), washer (53), two hex nuts (52) and spherical rod end bearings (51) to rod (56).

20 Install rod group (50).

21 Install lever (48), straight-headed pin (47), washer (46) and new cotter pin (45) on handle support (49).

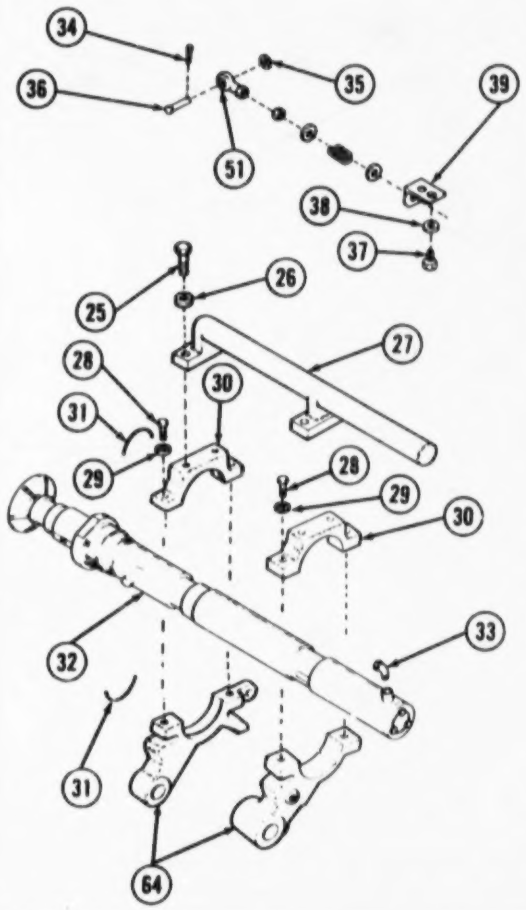
22 Install handle (44), straight headless pin (43) and two spring pins (42) on handle support (49).

23 Install handle group (41) and four screws (40) on tray (60).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY — Continued

d. Assembly-Continued



24 Install two washers (38) and two screws (37) on bracket (39).

25 Insert straight headed pin (36) into spherical rod end bearing (51).

26 Install washer (35) and new cotter pin (34) on straight-headed pin (36).

27 Install elbow (33) on cylinder assembly (32).

28 Install lower half of lock ring (31).

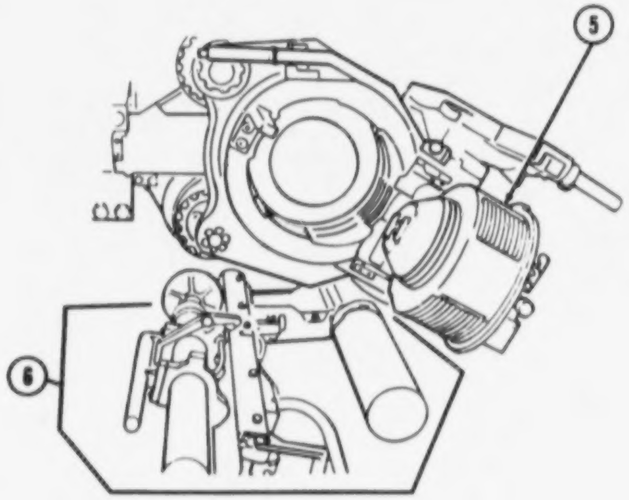
29 Install cylinder assembly (32).

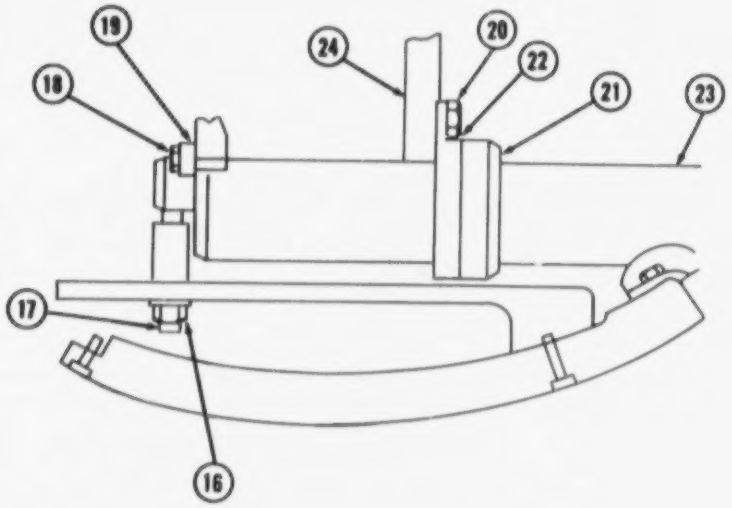
30 Install upper half of lock ring (31).

31 Install two caps (30), four washers (29) and four screws (28). Be sure to install two caps (30) with their respective matched front and rear cylinder supports (64).

32 Install handle (27), four washers (26) and four screws (25).

e. Installation





1 Open breechblock (5).

WARNING

Weight of rammer and shaft assembly is approximately 198 pounds (90 Kilograms). Two persons are required for removal and installation.

2 Slide rammer assembly (6) with front bumper (21) and spacer (22) into mount (24) on shaft (23).

3 Install screw (20) to front bumper (21) and spacer (22).

4 Install locking plate (19) and two screws (18).

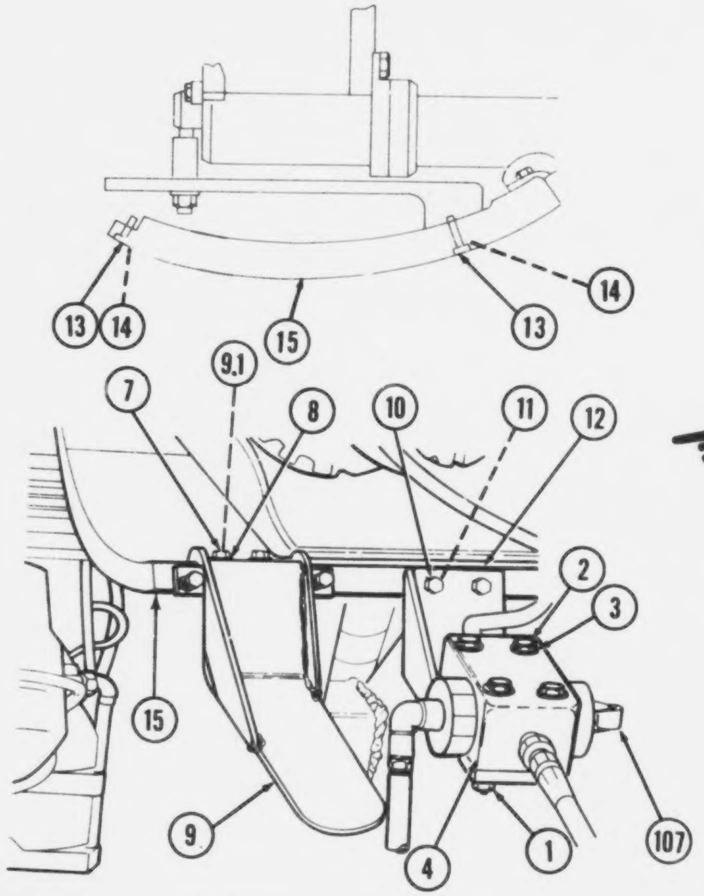
5 Adjust two shaft adjusting socket head cap screws (17) to aline rammer in cannon breech.

6 Hold two socket head cap screws (17) with a wrench while tightening two jam nuts (16).

RAMMER SYSTEM — Continued

6-2. RAMMER ASSEMBLY – Continued

e. Installation-Continued



WARNING

Weight of lower rotor shield is approximately 57 pounds (26 kilograms). Two persons are required for removal and installation. Lower rotor shield must be supported during removal and installation.

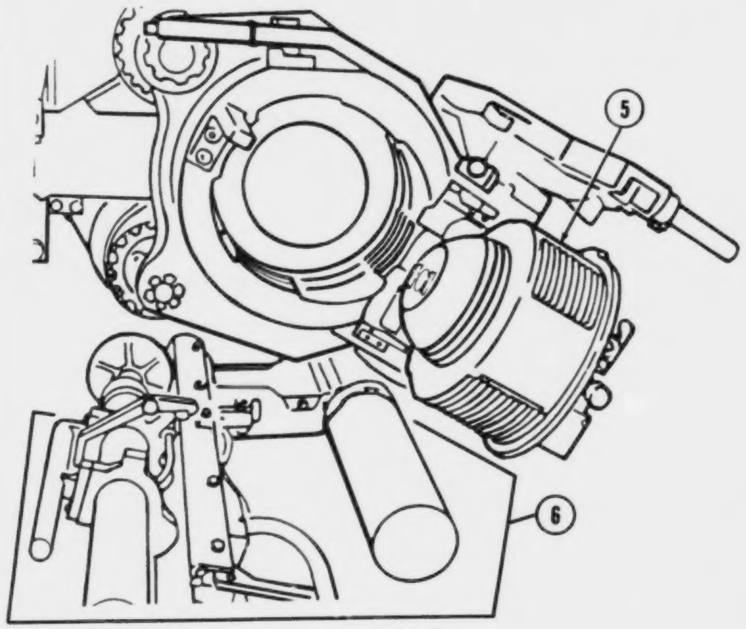
7 Install lower rotor shield (15), eight new lock washers (14), and eight new screws (13).

8 Install valve support bracket (12), two new lock washers (11) and two screws (10). Do not tighten two screws (10) yet.

NOTE

Do not spot paint ramp or plunger. Lubricate with grease.

9 Adjust valve support bracket (12) so that plunger (107) of blocking valve (4) is depressed when rammer assembly (6) is in ram position, then tighten two screws (10).



9.1 If replaced, install two new inserts (9.1) into lower rotor shield (15).

10 Install rammer support bracket (9), two washers (8), two screws and new lock wire (7).

11 Remove rammer assembly (6) to retracted position.

12 Close breechblock (5).

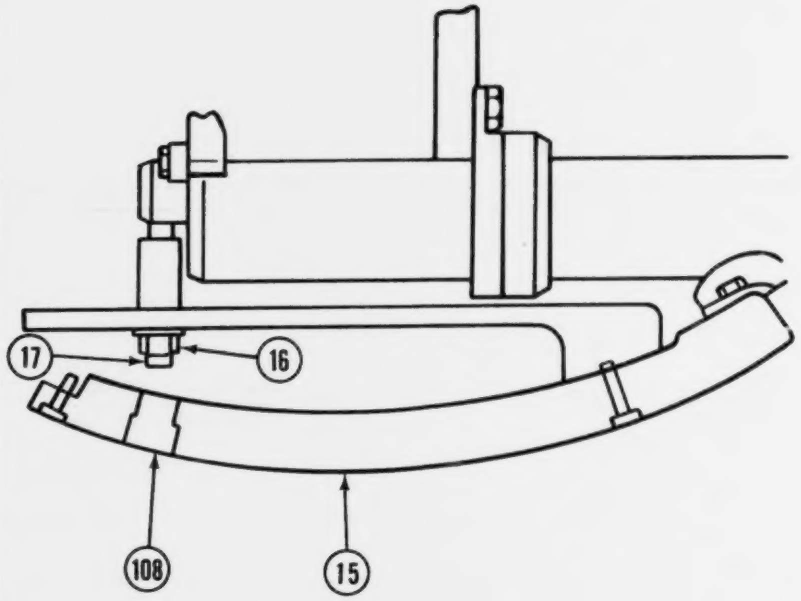
13 Install blocking valve (4), four new lock washers (3), four screws (2) and four nuts (1).

14 Install rammer lines and fittings (ref. page 6-2).

15 For adjustment of the rammer stowage bracket (ref. TM 9-2350-311-20-2).

16 Fill, charge and bleed hydraulic system (ref. TM 9-2350-311-20-2).

f. Adjustment



NOTE

This alinement procedure can be done during installation of rammer assembly (ref. page 6-21) or with lower rotor shield and rammer assembly already installed (see below).

1 Remove two plugs (108) from access holes of lower rotor shield (15).

2 Loosen two jam nuts (16) and adjust two socket head cap screws (17) through access holes to aline rammer in cannon breech.

3 Hold socket head cap screws (17) with a wrench and tighten two jam nuts (16).

4 Apply antiseizing compound and install two plugs (108).

RAMMER SYSTEM — Continued

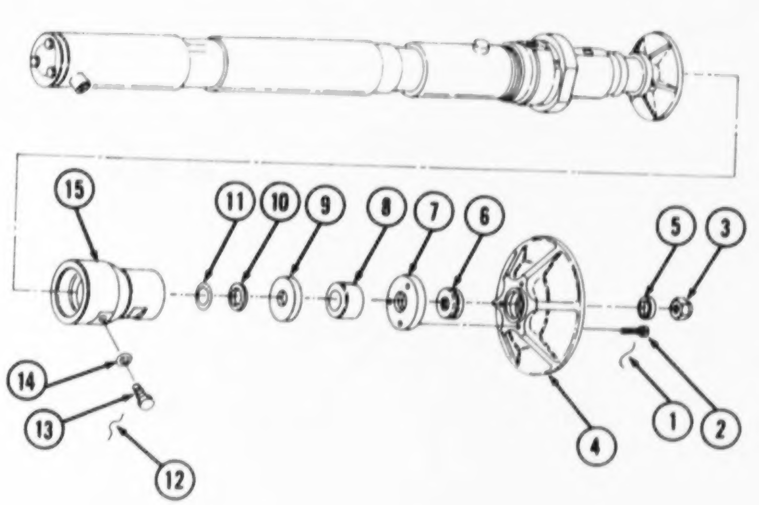
6-3. CYLINDER ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL SET-UP

Materials/Parts	Special Tools
Repair parts kit P/N 5910813	Micrometers, outside and inside
Lock wire	
Hydraulic fluid (Item 10, App. C)	

a. Disassembly



1 Remove rammer cylinder assembly and place on a solid work surface (ref. page 6-8).

2 Remove and discard lock wire (1).

3 Remove three socket head cap screws (2), plain nut (3) and swivel bearing (4).

4 Remove sleeve spacer (5).

5 Remove alining bearing (6).

6 Remove bearing collar (7).

7 Remove bearing cap (8).

8 Remove and discard piston wiper (9).

9 Remove and discard retainer (10).

10 Remove and discard preformed packing (11).

11 Remove and discard lock wire (12).

12 Remove plug (13).

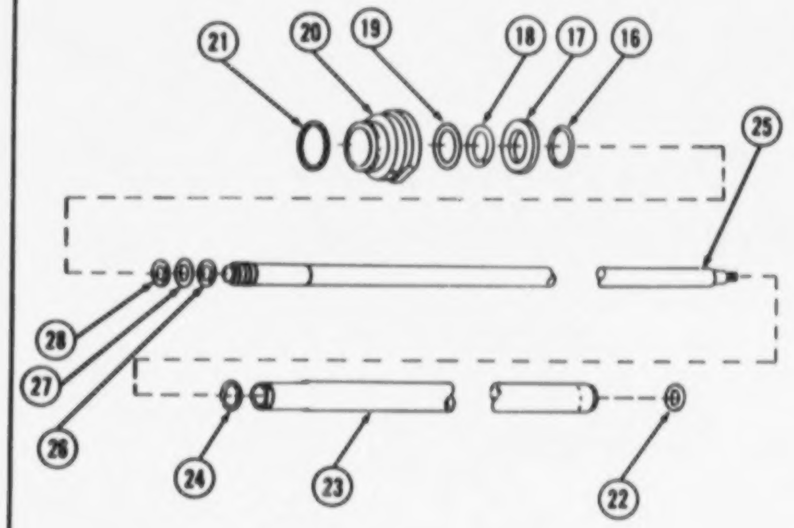
13 Remove and discard preformed packing (14).

14 Remove outer end housing (15).

RAMMER SYSTEM — Continued

6-3. CYLINDER ASSEMBLY — Continued

a. Disassembly-Continued



15 Remove and discard preformed packing (16).

16 Remove and discard piston wiper (17).

17 Remove and discard retainer (18).

18 Remove and discard preformed packing (19).

19 Remove cylinder guide (20).

20 Remove and discard preformed packing (21).

21 Remove washer (22).

22 Remove inner piston rammer tube (23).

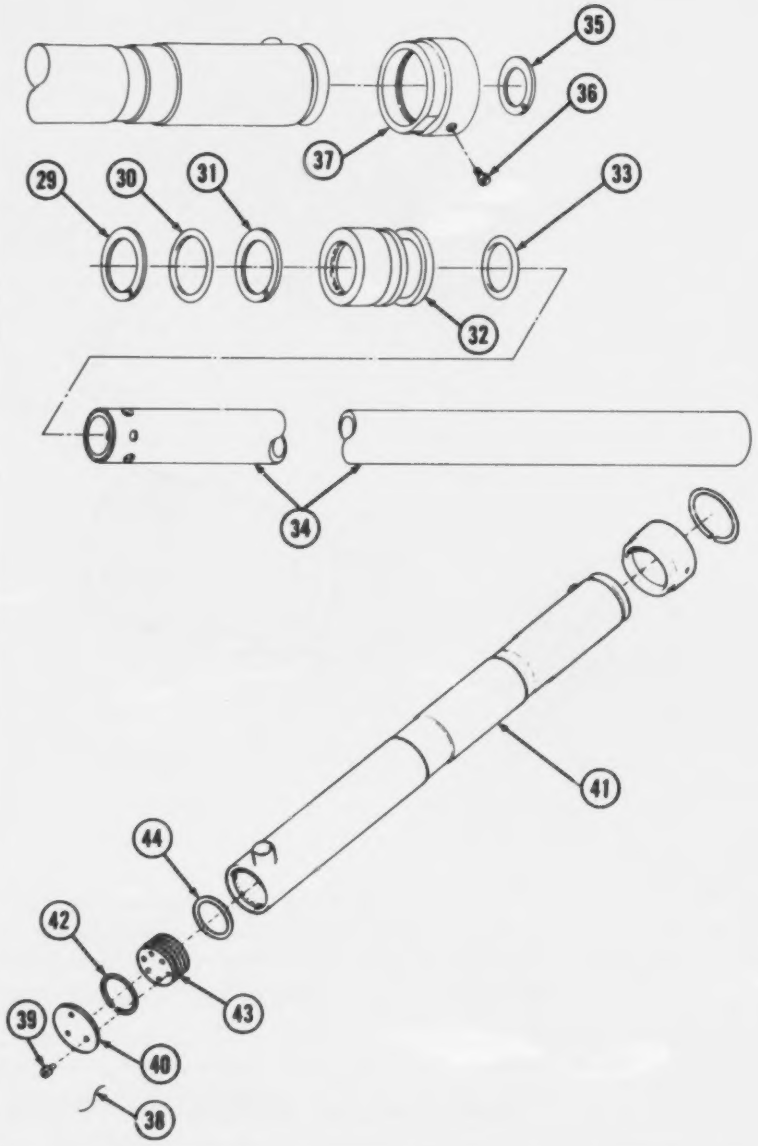
23 Remove lock ring (24).

24 Remove rammer cylinder piston assembly (25).

25 Remove and discard retainer (26).

26 Remove and discard preformed packing (27).

27 Remove and discard retainer (28).



28 Remove and discard retainer (29).

29 Remove and discard preformed packing (30).

30 Remove and discard retainer (31).

31 Remove sleeve bushing (32).

32 Remove and discard preformed packing (33).

33 Remove outer piston rammer tube (34).

34 Remove cylinder outer guide lock ring (35).

35 Remove setscrew (36).

36 Remove cylinder outer guide (37).

37 Remove and discard lock wire (38).

38 Remove three internal wrench bolts (39).

39 Remove outer end cap plate (40) from outer piston cylinder (41).

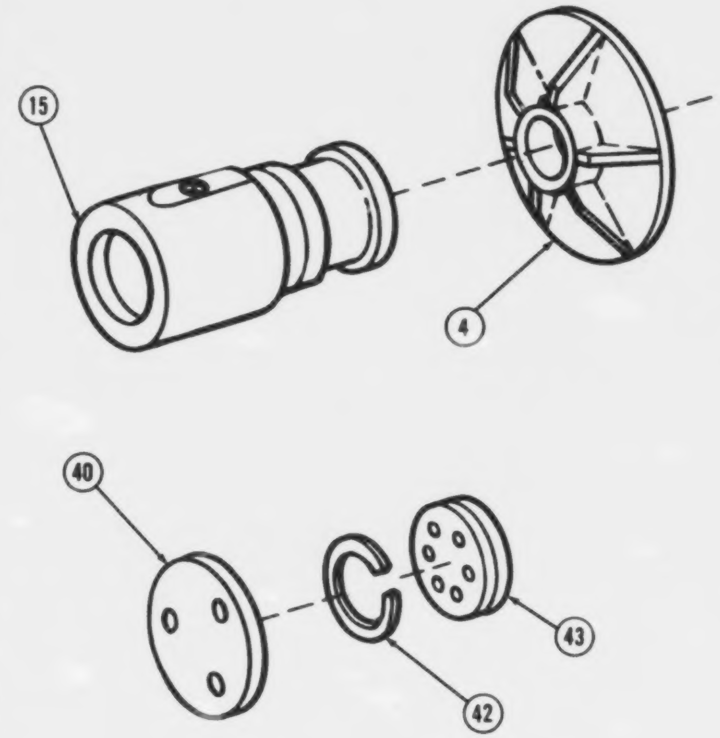
40 Remove cylinder outer end lock ring (42) and outer end cap (43).

41 Remove and discard preformed packing (44).

RAMMER SYSTEM — Continued

6-3. CYLINDER ASSEMBLY — Continued

b. Inspection and Repair



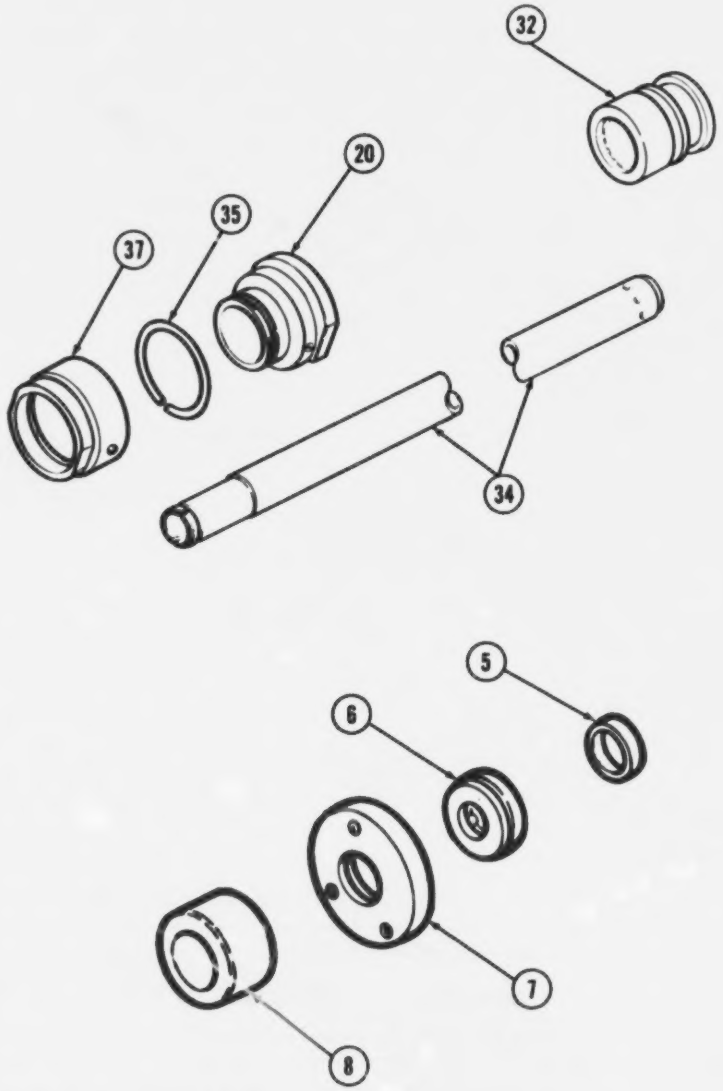
1 Inspect swivel bearing (4). Replace if scratched, scarred or severely worn.

2 Inspect outer end housing (15). Replace if cracked or if threads are damaged.

3 Inspect outer end cap (43). Replace if broken.

4 Inspect cylinder outer end lock ring (42). Replace if deformed.

5 Inspect outer end cap plate (40). Replace if broken.



6 Inspect outer piston rammer tube (34). Replace if scratched, broken or severely worn.

7 Inspect sleeve bushing (32). Replace if cracked, burred, nicked or distorted.

8 Inspect cylinder guide (20). Replace if cracked, burred, nicked or distorted.

9 Inspect cylinder outer guide lock ring (35). Replace if deformed.

10 Inspect cylinder outer guide (37). Replace if cracked, burred, nicked or distorted.

11 Inspect sleeve spacer (5). Replace if distorted.

12 Inspect alining bearing (6). Replace if distorted or excessively worn.

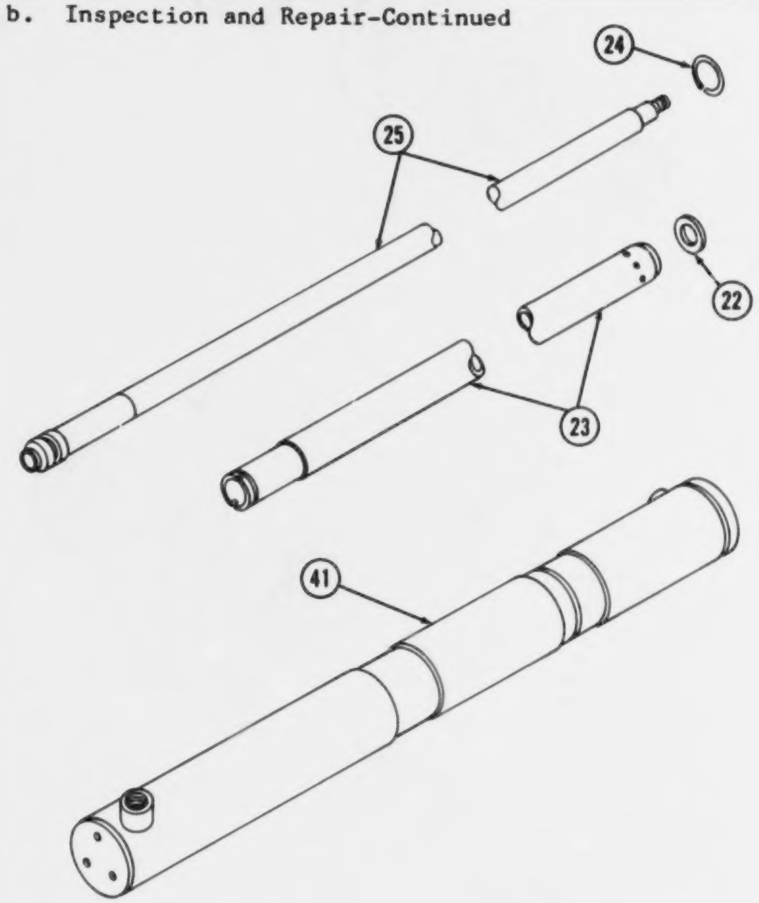
13 Inspect bearing collar (7). Replace if distorted or excessively worn.

14 Inspect bearing cap (8). Replace if cracked, burred, nicked or distorted.

RAMMER SYSTEM — Continued

6-3. CYLINDER ASSEMBLY — Continued

b. Inspection and Repair-Continued



15 Inspect washer (22). Replace if distorted.

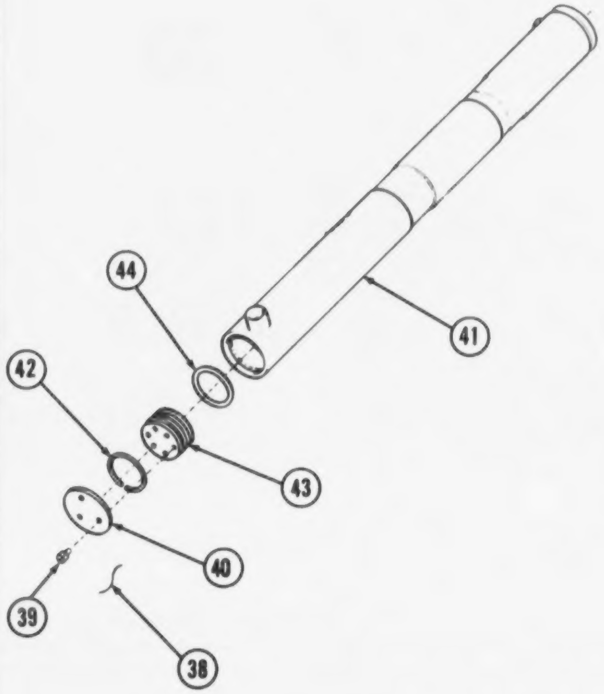
16 Inspect inner piston rammer tube (23). Replace if cracked, nicked, burred, distorted or if inside diameter is greater than 0.898 inch (22.8 mm).

17 Inspect lock ring (24). Replace if distorted.

18 Inspect rammer cylinder piston assembly (25). Replace if cracked, nicked, burred, distorted or if outside diameter is less than 0.892 inch (22.7 mm).

19 Inspect outer piston cylinder (41). Replace if cracked, nicked, burred, distorted or if inside diameter is greater than 2.155 inch (54.7 mm).

c. Assembly



NOTE

Coat all new preformed packings with hydraulic fluid (Item 10, App. C) before installing.

1 Install new preformed packing (44).

2 Install outer end cap (43) and cylinder outer end lock ring (42).

3 Install outer end cap plate (40) on outer piston cylinder (41).

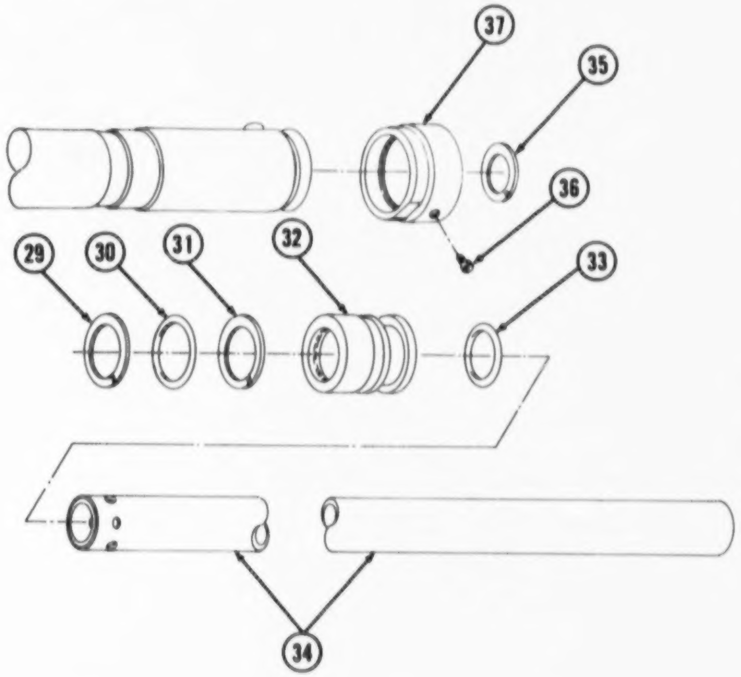
4 Install three internal wrench bolts (39).

5 Secure three internal wrench bolts (39) with new lock wire (38).

RAMMER SYSTEM — Continued

6-3. CYLINDER ASSEMBLY — Continued

c. Assembly-Continued



6 Install cylinder outer guide (37).

7 Install setscrew (36).

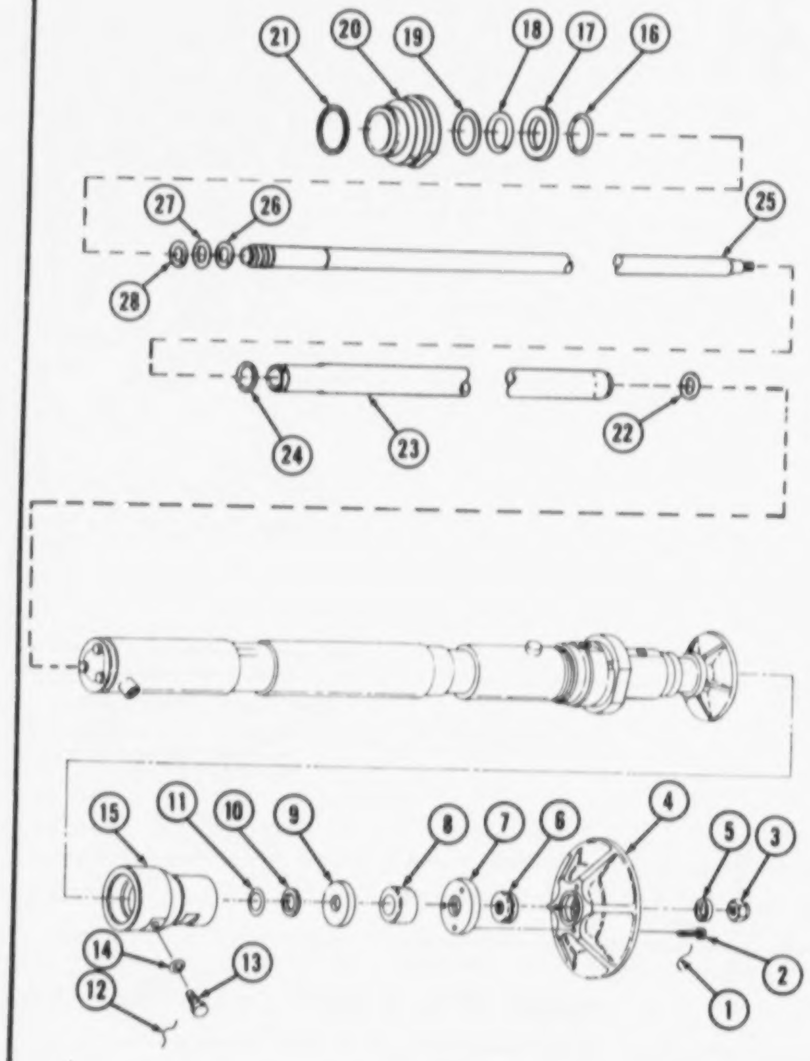
8 Install cylinder outer guide lock ring (35).

9 Install outer piston rammer tube (34).

10 Install new preformed packing (33).

11 Install sleeve bushing (32).

12 Install new retainer (31), new preformed packing (30) and new retainer (29).



13 Install new retainer (28), new preformed packing (27) and new retainer (26).

14 Install rammer cylinder piston assembly (25), lock ring (24), inner piston rammer tube (23) and washer (22).

15 Install new preformed packing (21).

16 Install cylinder guide (20).

17 Install new preformed packing (19), new retainer (18), new piston wiper (17) and new preformed packing (16).

18 Install outer end housing (15).

19 Install new preformed packing (14) and plug (13). Secure plug (13) with new lock wire (12).

20 Install new preformed packing (11), new retainer (10) and new piston wiper (9).

21 Install bearing cap (8), bearing collar (7) and alining bearing (6).

22 Install sleeve spacer (5).

23 Install swivel bearing (4), plain nut (3) and three socket head cap screws (2).

24 Secure three socket head cap screws (2) with new lock wire (1).

25 Install rammer cylinder assembly (ref. page 6-20).

RAMMER SYSTEM — Continued

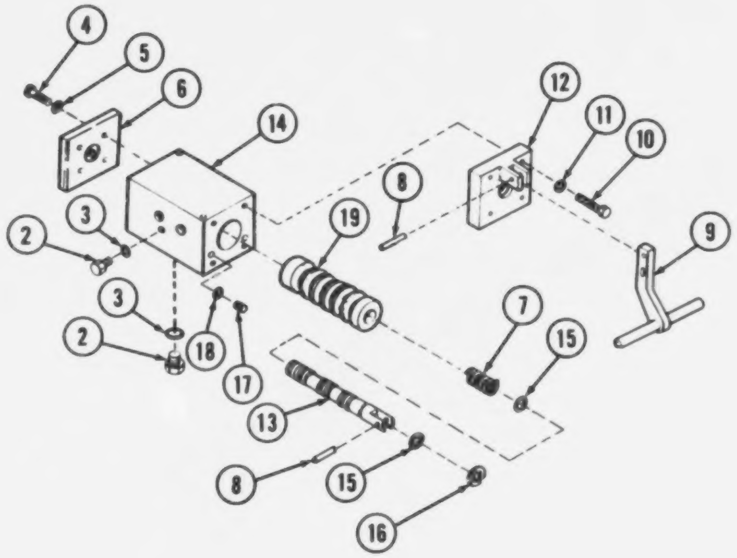
6-4. RAMMER ACTUATING VALVE ASSEMBLY

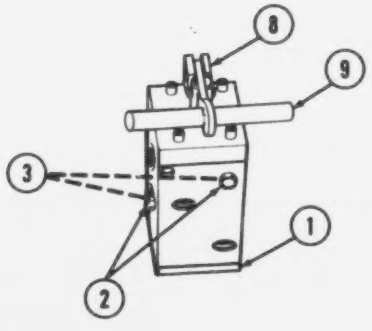
This task covers: a. Disassembly b. Inspection and Repair c. Assembly

INITIAL SET-UP

Materials/Parts
Hydraulic fluid (Item 10, App. C)
Preformed packings

a. Disassembly





1 Remove rammer actuating valve assembly (1) (ref. TM 9-2350-311-20-2).

2 Remove two plugs (2) and two preformed packings (3). Discard two preformed packings (3).

WARNING

Springs beneath cover are under high preload. Make provision to restrain cover during disassembly.

3 Remove four socket head cap screws (4), four lock washers (5), cover (6) and spring (7). Discard four lock washers (5).

4 Remove two spring pins (8) and manual control lever (9).

5 Remove four socket head cap screws (10), four lock washers (11) and cover (12). Discard four lock washers (11).

6 Withdraw spool (13) from valve body (14).

7 Remove and discard two preformed packings (15) from spool (13).

8 Remove retaining ring (16) from spool (13).

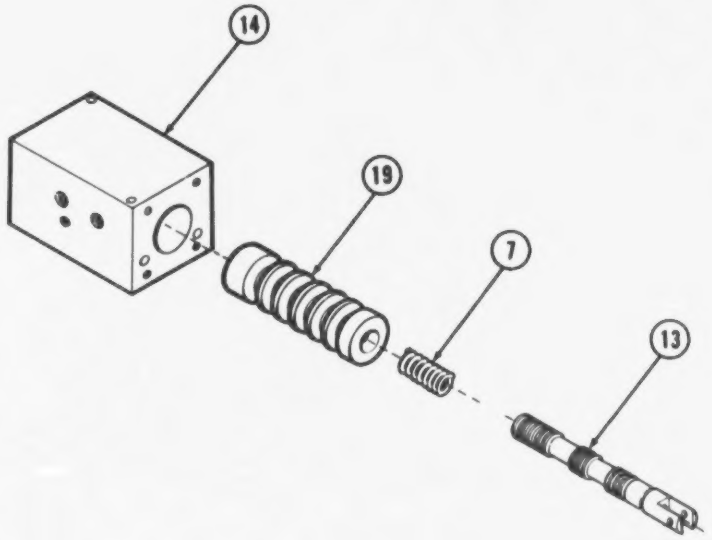
9 Remove two plugs (17) and two preformed packings (18). Discard two preformed packings (18).

10 Remove sleeve (19).

RAMMER SYSTEM — Continued

6-4. RAMMER ACTUATING VALVE ASSEMBLY — Continued

b. Inspection and Repair

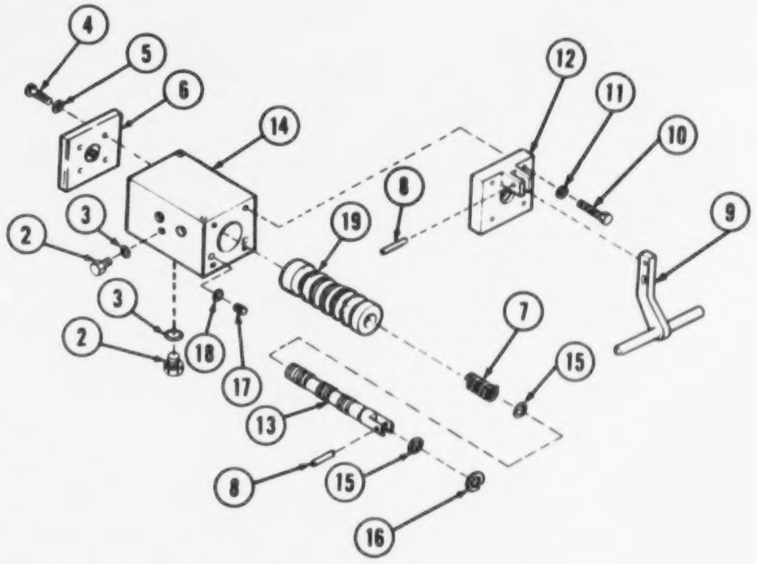


1 Inspect spring (7). Replace if cracked, nicked, distorted or broken.

2 Inspect valve body (14). Replace if cracked or distorted.

3 Inspect spool (13) and sleeve (19). Replace if cracked, distorted or scored.

c. Assembly



1 Install sleeve (19).

2 Install two new preformed packings (18) and two plugs (17).

3 Install retaining ring (16) and two new preformed packings (15) on spool (13).

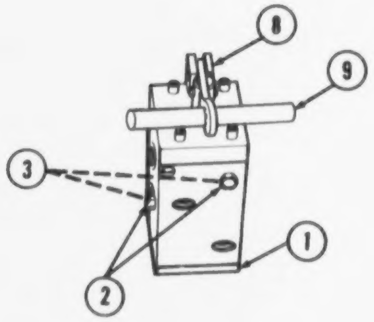
4 Coat spool (13) with hydraulic fluid (Item 11, App. C). Install spool (13) in valve body (14).

5 Install cover (12), four new lock washers (11), and four socket head cap screws (10).

6 Install manual control lever (9) and two spring pins (8).

WARNING

Spring must be compressed to assemble. Make provision to contain parts against sudden release during assembly.



7 Coat spring (7) with hydraulic fluid (Item 10 App. C). Install spring (7), cover (6) four new lock washers (5) and four socket head cap screws (4).

8 Install two new preformed packings (3) and two plugs (2).

9 Install rammer actuating valve assembly (1) (ref. TM 9-2350-311-20-2).

CHAPTER 7 ELECTRICAL CONTACT SEGMENT RING

GENERAL

This chapter describes and illustrates repair procedures for electrical contact segment ring and electrical contact arm. These maintenance procedures are functions authorized for direct and general support level maintenance.

Title		Page
7-1.	ELECTRICAL CONTACT SEGMENT RING	7-2
7-2.	ELECTRICAL CONTACT ARM	7-6

ELECTRICAL CONTACT SEGMENT RING — Continued

7-1. ELECTRICAL CONTACT SEGMENT RING

This task covers: Inspection and Repair

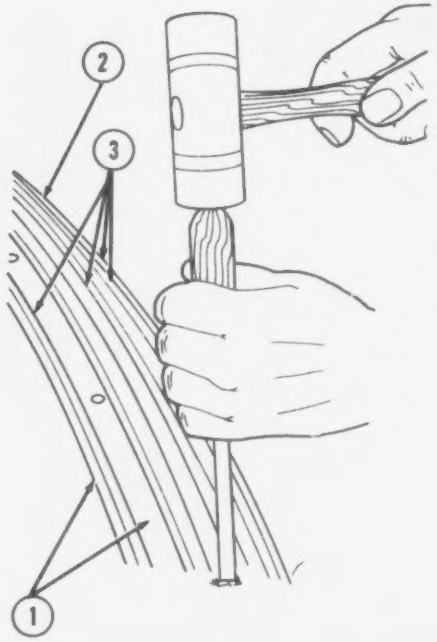
INITIAL SET-UP

Materials/Parts	Special Tools
Adhesive (Item 1, App. C)	Wood chisel
Epoxy adhesive (Item 2, App. C)	Wire brush
Copper sheet 0.125 ± .001 inch thick	

Inspection and Repair

WARNING

- Personnel must wear safety glasses to avoid eye injury.
- Make sure CAB POWER and MASTER switches are OFF (ref. TM 9-2350-311-10). Disconnect battery ground cable at battery terminal (ref. TM 9-2350-311-20-1). Failure to follow this procedure could result in serious burns or electrical shock.



NOTE

- For removal and installation of electrical contact segment ring, ref. TM 9-2350-311-20-2.
- Vehicles with three electrical contact arms have an electrical contact segment ring consisting of two ring segments.
- Vehicles with five electrical contact arms have a one-piece electrical segment ring.

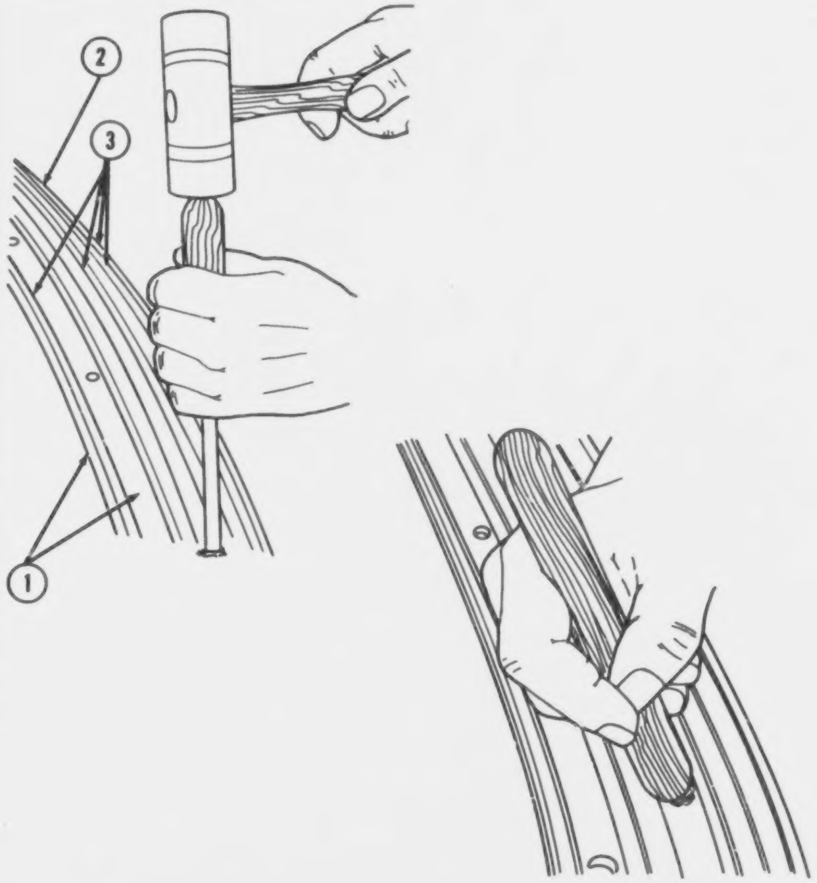
1 Clean bus bars (1) of electrical contact ring segment(s) (2) with wire brush. Bus bars (1) are the two wide polished metal contact strips on electrical contact ring segment(s) (2). Clean narrow polished metal contact strips (3). Be careful not to damage polished metal surfaces on contact strips (3).

2 Inspect electrical contact ring segment(s) (2) for cracks. Repair cracks with epoxy adhesive (Item 2, App. C).

ELECTRICAL CONTACT SEGMENT RING — Continued

7-1. ELECTRICAL CONTACT SEGMENT RING — Continued

Inspection and Repair-Continued



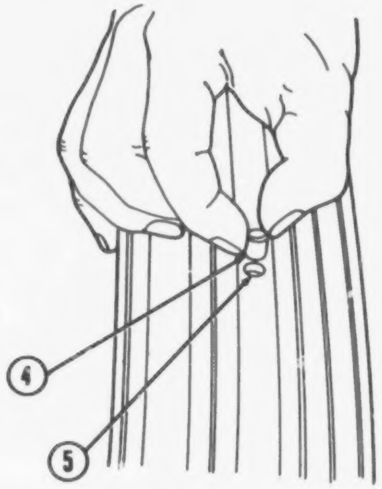
3 Inspect bus bars (1) and narrow polished metal contact strips (3) for looseness. Re-bond loose bus bars (1) or narrow polished metal contact strips (3) to electrical contact ring segment(s) (2) with epoxy adhesive (Item 2, App. C).

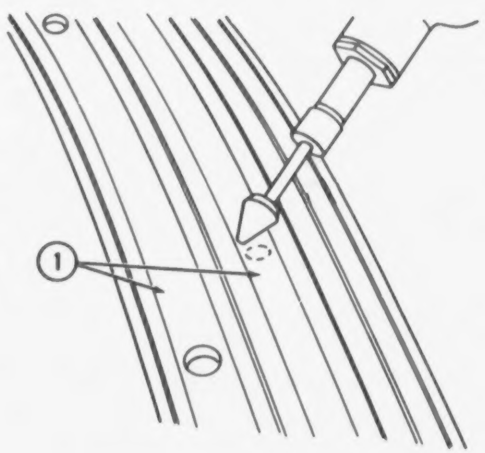
4 Inspect bus bars (1) for metal mounds caused by arcing. Use wood chisel (or similar sharp tool) and soft-headed mallet to remove any metal mounds.

5 Inspect bus bars (1) for small surface pits. Fill very small surface pits with epoxy adhesive (Item 2, App. C).

6 Inspect bus bars (1) for large damaged areas or deep pits. Repair as follows:

a Mill or rout out large damaged areas to a constant depth of 0.125 in. (3.0 mm) ± 0.001 (.025 mm).





b Machine copper insert (4) of 0.125 ± 0.001 inch (3.0 mm ± .025 mm) thickness. Do not alow more than 1/64 inch (0.4 mm) at ends, and 1/32 inch (0.2 mm) along sides for adhesive (Item 1, App. C). Electrical contact with bus bars (1) should be made by base of copper insert (4).

c Bond copper insert (4) into machined area (5) with adhesive (Item 1, App. C). Check surface for smoothness after copper insert (4) bond has cured.

d If necessary, use grinder to grind copper insert (4) smooth to within 0.001 inch (.025 mm) of bus bars (1). Avoid grinding polished metal surface off bus bars (1).

ELECTRICAL CONTACT SEGMENT RING — Continued

7-2. ELECTRICAL CONTACT ARM

This task covers: Repair

For repair of electrical arm assembly, ref. TM 9-2350-311-20-2.

CHAPTER 8 CAB WEATHER COVER

GENERAL

This chapter describes and illustrates removal, disassembly, inspection and repair, assembly and installation procedures for cab weather cover assembly. These maintenance procedures are functions authorized for direct and general support level maintenance.

Title	Page
CAB WEATHER COVER	8-2

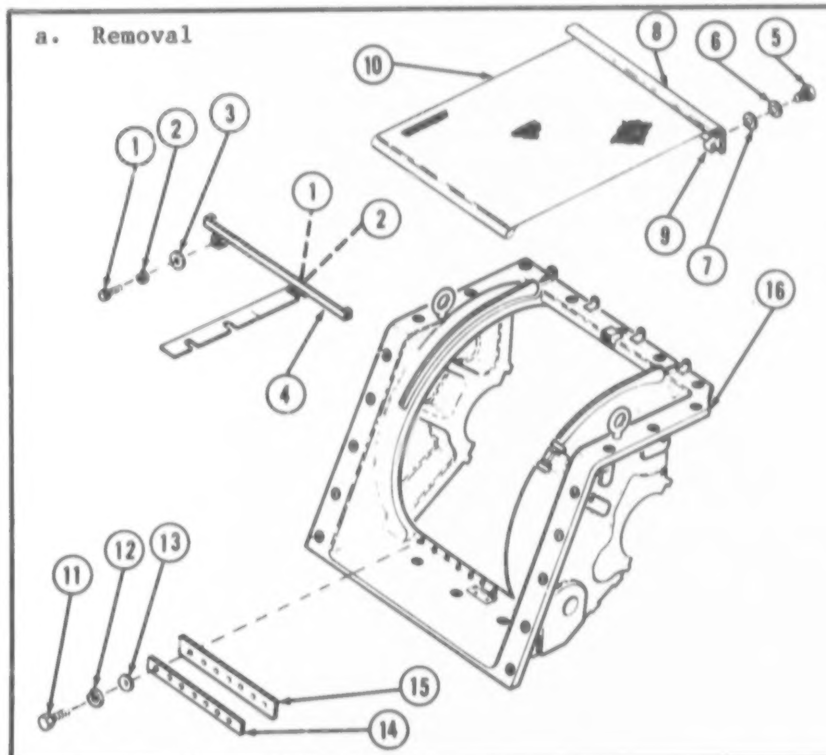
CAB WEATHER COVER

This task covers: a. Removal b. Disassembly c. Inspection and Repair
d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts
Adhesive, (Item 4, App. C)
Adhesive, (Item 5, App. C)
Solid film lubricant (Item 12, App. C)
Lock washers

a. Removal

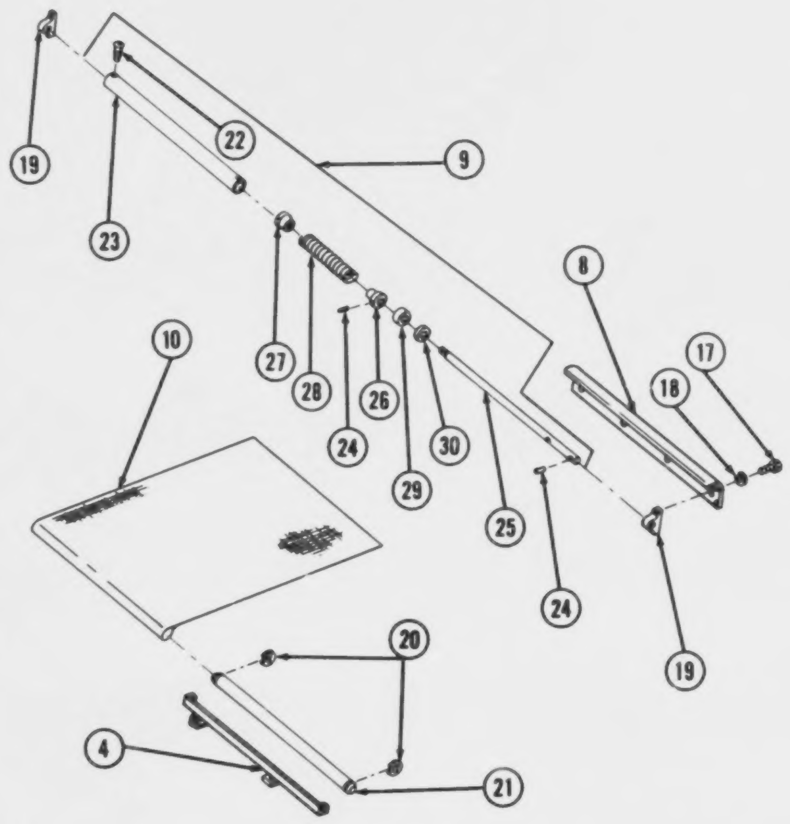


1 Remove two screws (1), two lock washers (2), two flat washers (3) and curtain support (4). Discard two lock washers (2).

2 Remove four screws (5), four lock washers (6), four flat washers (7), upper bracket (8), roller assembly (9) and curtain (10). Discard four lock washers (6).

3 Remove seven screws (11), seven lock washers (12), seven flat washers (13), backing strip (14) and rubber seal (15) from trunnion mounting bracket (16). Discard seven lock washers (12).

b. Disassembly



1 Remove four cap screws (17), four lock washers (18), two curtain brackets (19) and roller assembly (9) from upper bracket (8). (Shaft (23) will unwind four revolutions clockwise when two curtain brackets (19) are separated from upper bracket (8)). Discard four lock washers (18).

2 To disassemble roller assembly (9), remove two retaining rings (20) from shaft (21).

3 Remove shaft (21) from curtain support (4) and curtain (10).

4 Remove two screws (22) from ends of shaft (23).

5 Slide out shaft (25), spring pin (24), flat washer (3), collar (29), spring anchor (26), spring pin (24), helical spring (28) and spring anchor (27) as an assembly.

6 Remove one spring pin (24) from shaft (25) and one spring pin (24) from spring anchor (26). Discard both spring pins (24).

7 Separate two spring anchors (26) and (27), helical spring (28), collar (29) and flat washer (30) from shaft (25).

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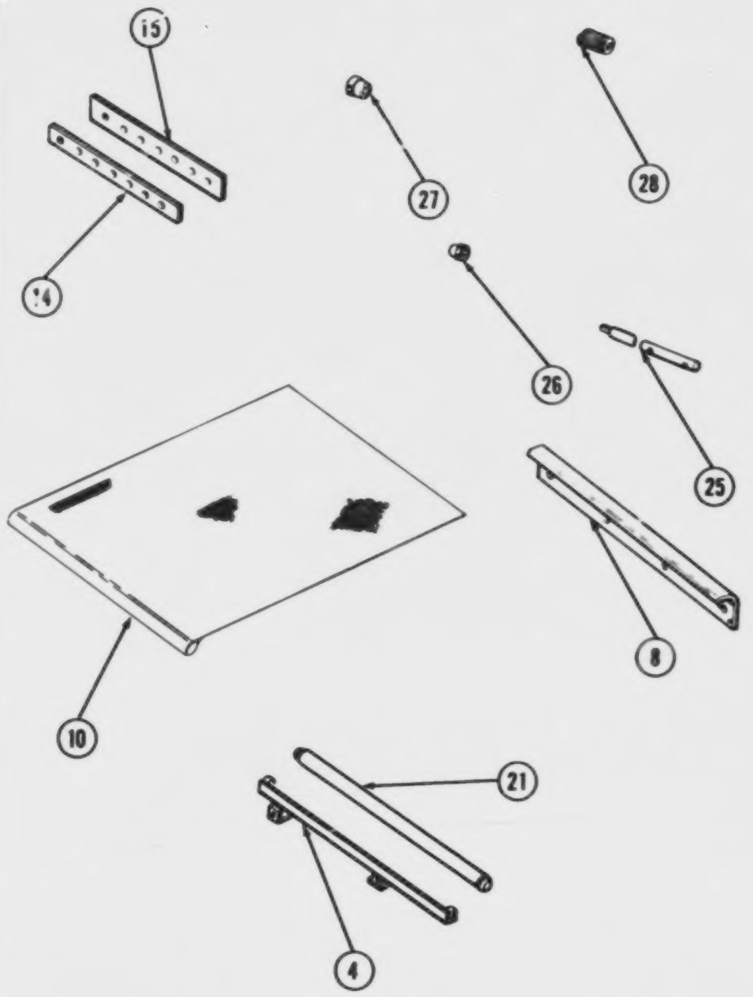
CAB WEATHER COVER — Continued

c. Inspection and Repair



1 Inspect backing strip (14). Repair if there are burrs or sharp edges.

2 Inspect rubber seal (15). Replace if deteriorated or worn.

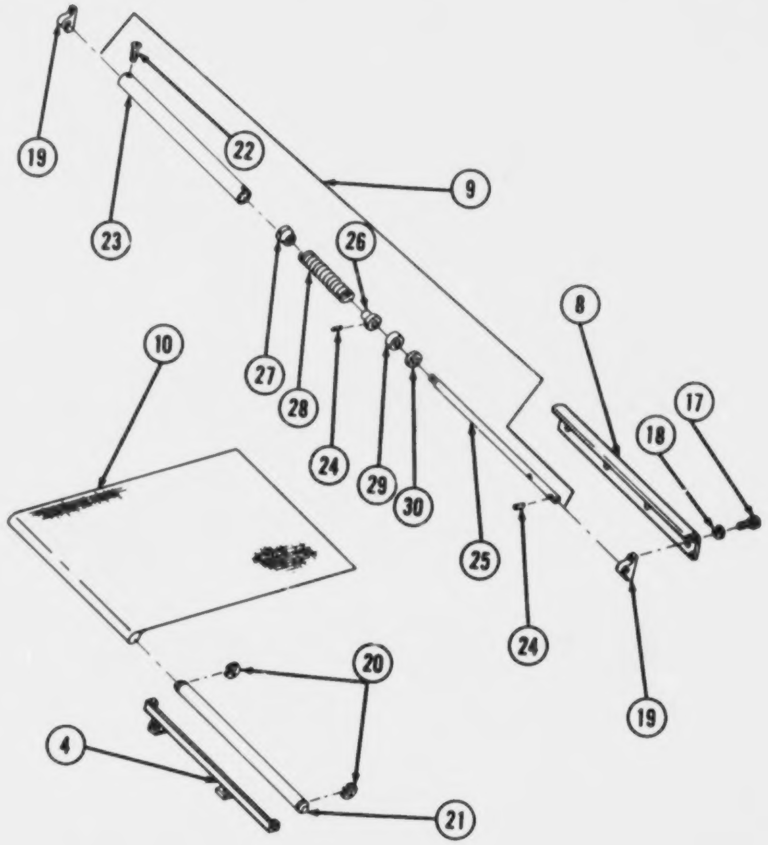
3 Inspect helical spring (28). Replace if distorted.

4 Inspect two spring anchors (26) and (27) and shaft (25). Replace if damaged.

5 Inspect curtain (10). Replace if worn, torn or discolored. Check bonding. If bonding is failing, bond to tube with adhesive (Item 5, App. C). Bond folded end with adhesive (Item 4, App. C).

6 Inspect upper bracket (8), shaft (21) and curtain support (4). Repair if there are burrs or sharp edges. Replace if cracked or distorted.

d. Assembly



1 To assemble roller assembly (9), attach flat washer (30), collar (29), helical spring (28) and two spring anchors (27 and 26) to shaft (25).

2 Install two new spring pins (24) on spring anchor (26) and shaft (25). Apply solid film lubricant (Item 12, App. C) over assembled parts.

3 Slide in spring anchor (27), helical spring (28), spring pin (24), spring anchor (26), collar (29), flat washer (30) spring pin (24) and shaft (25) as an assembly.

4 Install two screws (22) on ends of shaft (23).

5 Install shaft (21) into curtain (10) and curtain support (4).

6 Install two retaining rings (20) onto shaft (21).

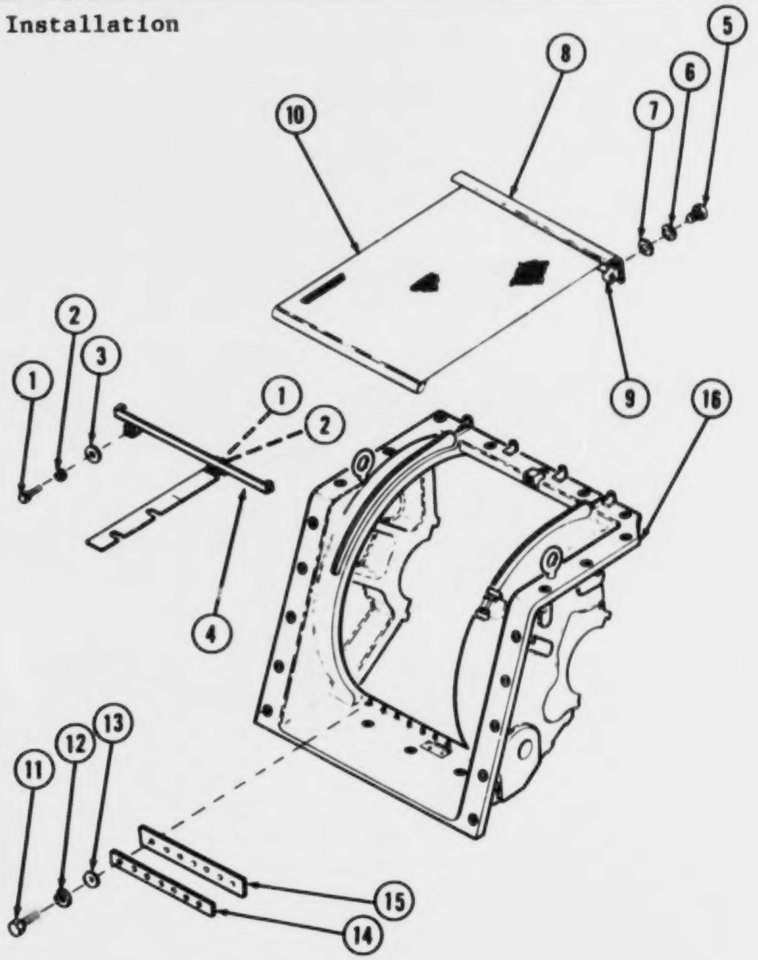
7 To install roller assembly (9) onto upper bracket (8), roll curtain (10) up.

8 Mount right curtain bracket (19). Wind left curtain bracket (19) four turns counterclockwise.

9 Hold in position and install four new lock washers (18) and four cap screws (17) onto upper bracket (8).

CAB WEATHER COVER — Continued

e. Installation



1 Install rubber seal (15), backing strip (14), seven flat washers (13) seven new lock washers (12) and seven screws (11) onto trunnion mounting bracket (16).

2 Install roller assembly (9) with curtain (10), uppper bracket (8), four flat washers (7), four new lock washers (6) and four screws (5).

3 Install curtain support (4), two flat washers (3), two new lock washers (2) and two screws (1).

CHAPTER 9 TRAVERSING MECHANISM ASSEMBLY

GENERAL

This chapter illustrates and describes the repair of the traversing mechanism assembly which consists of the major groups and important components illustrated below:

Title — Page

9-1. MANUAL TRAVERSE CLUTCH BRUSH ASSEMBLY (M109A2/M109A3) 9-2

9-2. LUBRICATING PUMP AND LINES 9-6

9-3. RELIEF VALVE ASSEMBLY 9-16

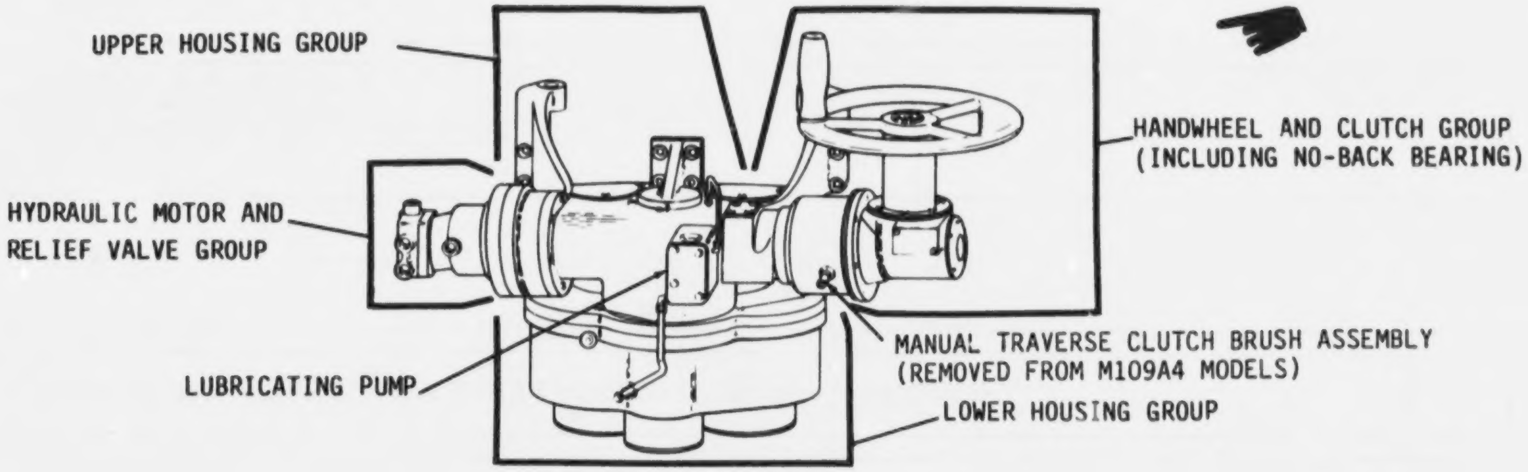
9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER 9-28

9-5. MANUAL TRAVERSE HANDWHEEL ASSEMBLY AND NO-BACK BEARING 9-40

9-6. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A2/M109A3) 9-46

9-6.1. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A4) 9-48.2

9-7. TRAVERSING MECHANISM 9-50


UPPER HOUSING GROUP
HANDWHEEL AND CLUTCH GROUP (INCLUDING NO-BACK BEARING)
HYDRAULIC MOTOR AND RELIEF VALVE GROUP
LUBRICATING PUMP
MANUAL TRAVERSE CLUTCH BRUSH ASSEMBLY (REMOVED FROM M109A4 MODELS)
LOWER HOUSING GROUP

TRAVERSING MECHANISM ASSEMBLY — Continued

9-1. MANUAL TRAVERSE CLUTCH BRUSH ASSEMBLY (M109A2/M109A3)

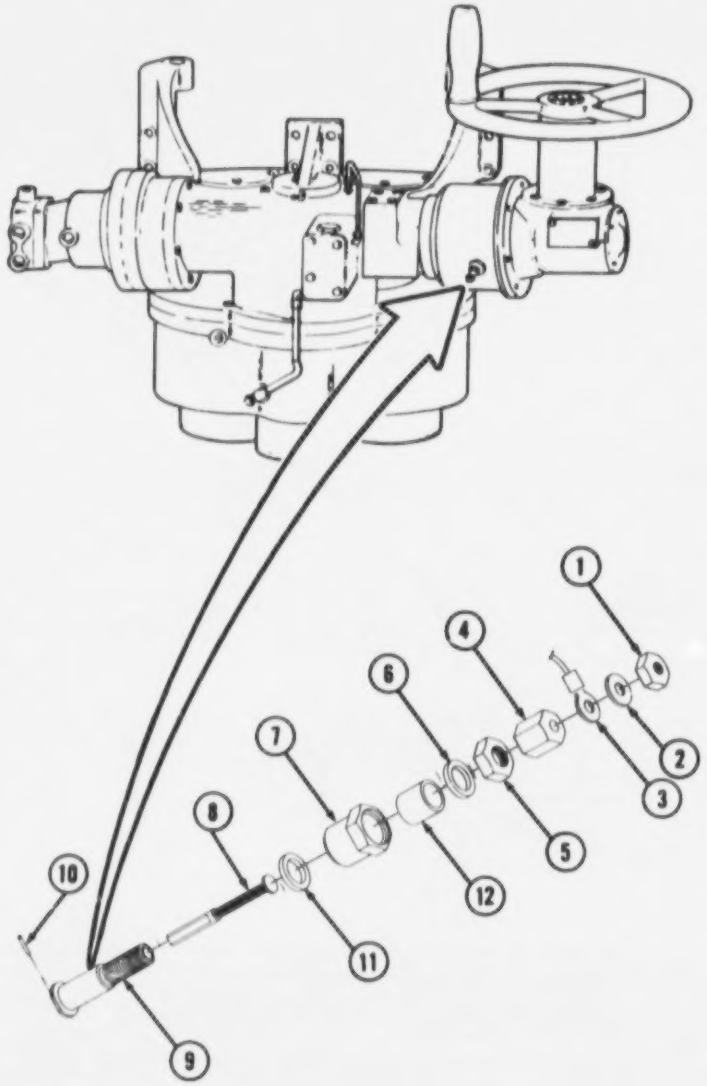
This task covers: a. Removal b. Inspection c. Installation

INITIAL SET-UP

Materials/Parts

Sealing compound, grade H
(Item 24, App. C)

a. Removal



NOTE

Turn electrical CAB POWER OFF before removing clutch brush assembly.

1 Remove hex nut (1), flat washer (2) and terminal (3) from end of contact assembly (8).

2 Remove terminal adapter (4), hex nut (5) and spacer (6) from bushing (7).

3 Remove bushing (7), contact assembly (8) and spacers (11 and 12) as an assembly from clutch housing.

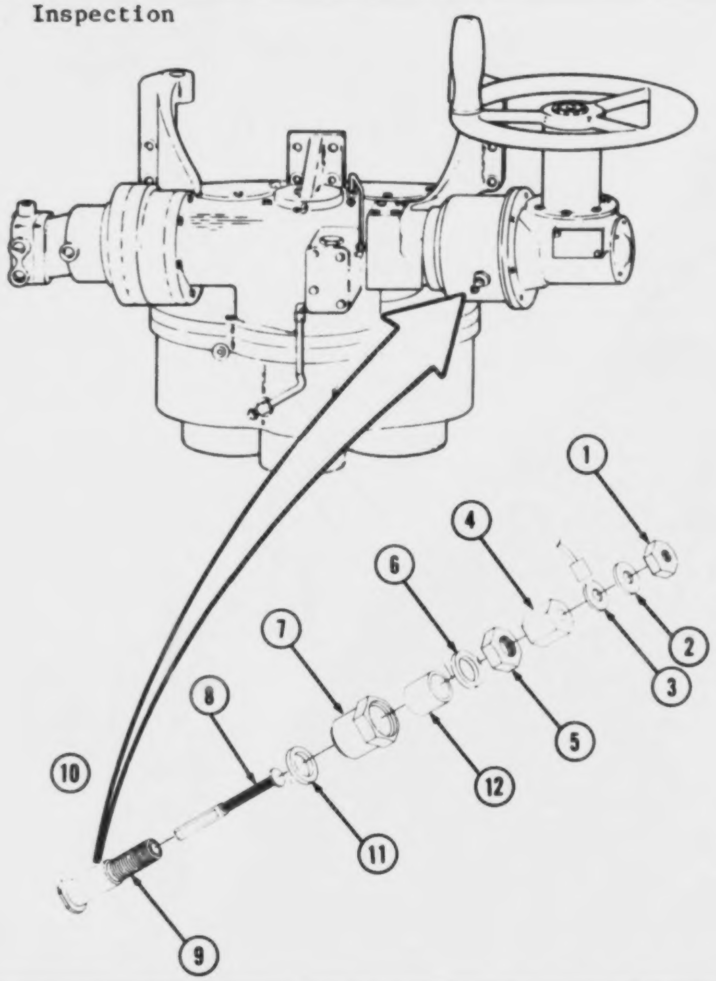
4 Remove bushing (9) from clutch housing. Do not drive out pin (10) from bushing unless replacement is necessary.

5 Remove spacers (11 and 12) from bushing (7).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-1. MANUAL TRAVERSE CLUTCH BRUSH ASSEMBLY (M109A2/M109A3)—Continued

b. Inspection



1 Inspect threads of hex nut (1), terminal adapter (4), hex nut (5), bushing (7) and contact assembly (8). Replace if damaged.

2 Inspect terminal (3). If loose, solder to wire (ref. TB SIG 222).

3 Inspect contact assembly (8). Replace if spring is broken.

4 Inspect all other parts for damage and replace as required.

c. Installation

1 Install spacers (11 and 12) into bushing (7).

2 Insert contact assembly (8) into bushing (9).

3 Install bushing (9) with contact assembly (8) and pin (10), if removed, into clutch housing.

4 Apply sealing compound, grade H (Item 24, App. C) to threads of terminal adapter (4).

5 Install spacer (6) into bushing (7). Secure with hex nut (5) and terminal adapter (4).

6 Install wire with terminal (3), flat washer (2) and hex nut (1) on threaded end of contact assembly (8).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-2. LUBRICATING PUMP AND LINES

This task covers: a. Removal b. Disassembly c. Inspection d. Assembly e. Installation

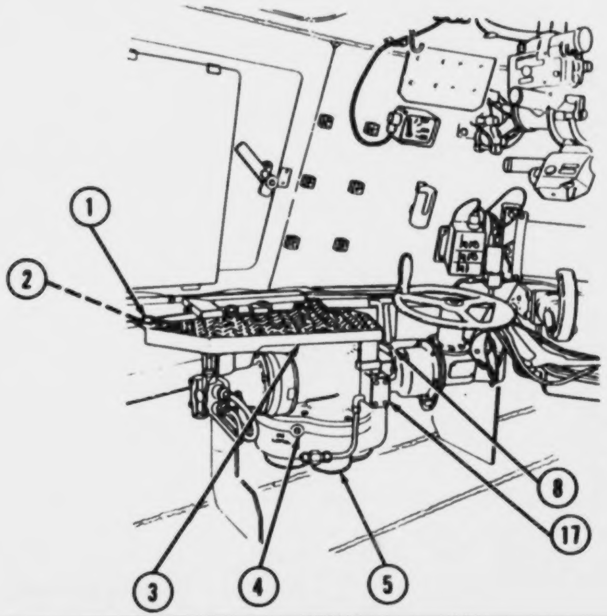
INITIAL SET-UP

Materials/Parts

Repair parts kit P/N 10918677

Four quarts lubricating oil (Item 15, App. C)

Lock washers



WARNING

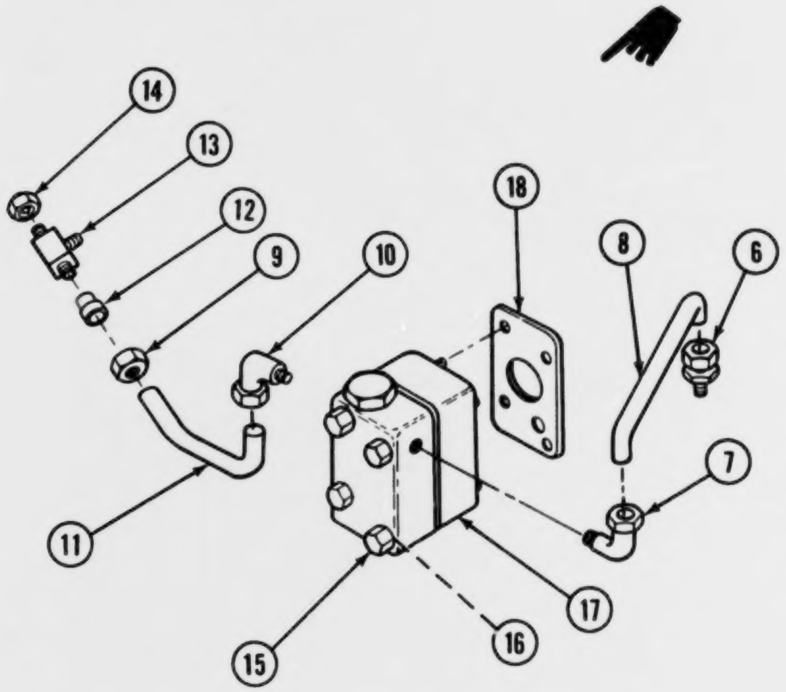
Wear safety glasses and steel-tipped shoes to avoid possible injury while handling equipment.

1 Relieve hydraulic system pressure before removing the lubricating pump and lines (ref. TM 9-2350-311-20-2).

2 Remove two screws (1), two flat washers (2) and step plate (3) to gain access to outlet tube (8) and lubricating pump assembly (17).

3 Remove oil level check and fill hole plug (4).

4 Place drain pan of at least two-gallon capacity under drain plug (5) at bottom center of lower housing. Remove drain plug (5) and drain lubricant. Install drain plug (5) and tighten.



5 Loosen compression hex nuts of adapter (6) and elbow (7). Remove outlet tube (8).

6 Remove adapter (6) from upper housing of traversing mechanism assembly.

7 Remove elbow (7) from lubricating pump assembly (17).

8 Loosen compression hex nut (9) and compression hex nut of elbow (10). Remove inlet tube (11).

9 Remove elbow (10) from lubricating pump assembly (17).

10 Remove compression hex nut (9) and sleeve (12) from tee (13).

11 Remove plug (14) from tee (13).

12 Remove tee (13) from lower housing of traversing mechanism assembly.

NOTE

Hold pump assembly parts together when removing from upper housing of traversing mechanism assembly.

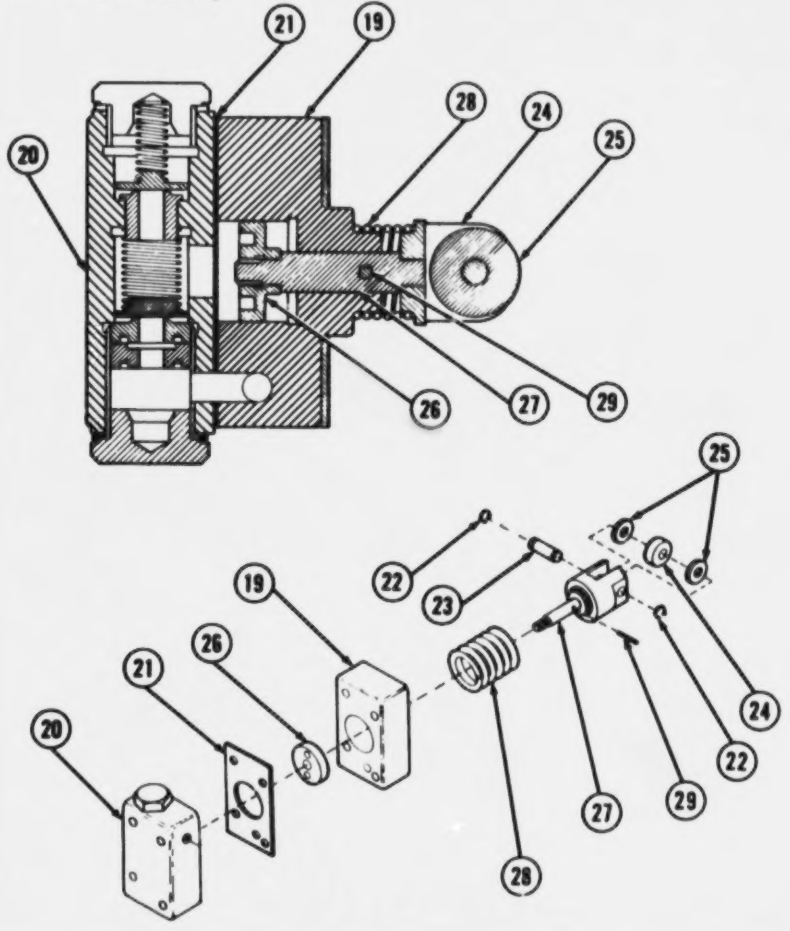
13 Remove four cap screws (15), four lock washers (16) and lubricating pump assembly (17). Discard four lock washers (16).

14 Remove and discard gasket (18).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-2. LUBRICATING PUMP AND LINES – Continued

b. Disassembly



1 Separate pump body (19) from valve plate (20). Remove and discard gasket (21).

2 Remove and discard two retaining rings (22) from cam roller grooved pin (23).

3 Remove cam roller grooved pin (23) from clevis of stem assembly (27).

4 Remove cam roller (24) and two flat washers (25) from clevis of stem assembly (27).

WARNING

Compressed spring is under preload. Wear eye protection and make provision to contain parts when preload is released during disassembly.

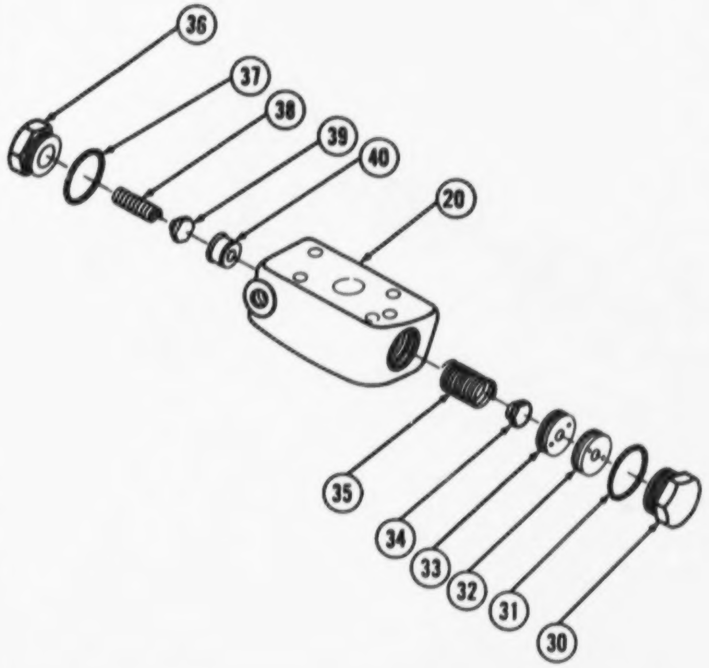
NOTE

Threads of stem may have been staked to secure plunger.

5 Unscrew plunger (26) from threaded end of stem of stem assembly (27).

6 Remove stem assembly (27) and spring (28) from pump body (19). Discard spring (28).

7 Drive pin (29) from stem assembly (27).



8 Place valve plate (20) in a soft-jawed vise.

9 Remove and discard lower plug (30) and gasket (31).

WARNING

Compressed springs are under preload. Wear eye protection and make provision to contain parts when preload is released during disassembly.

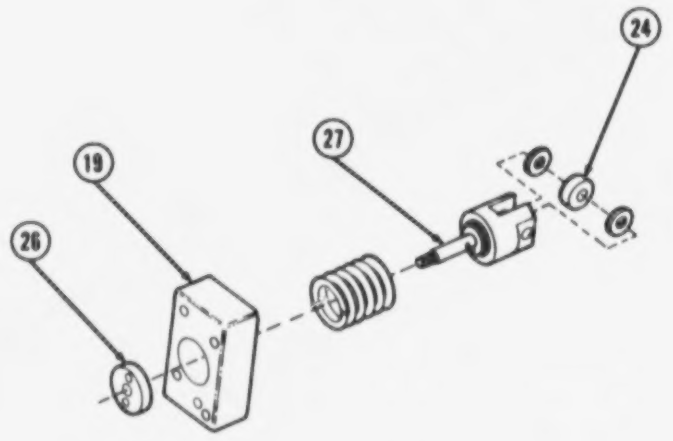
10 Remove and discard retaining ring (32), inlet valve seat (33), inlet valve (34) and spring (35) from pump plate (20).

11 Remove and discard upper plug (36), gasket (37), spring (38), outlet valve (39) and outlet valve seat (40) from pump plate (20).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-2. LUBRICATING PUMP AND LINES – Continued

c. Inspection



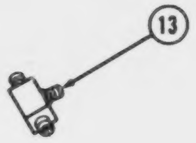
1 Measure inside diameter of cam roller (24). Replace if greater than 0.2540 inch (6.5 mm).

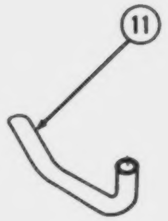
2 Measure outside diameter of stem of stem assembly (27). Replace if less than 0.3735 inch (9.5 mm).

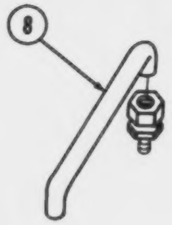
3 Measure inside diameter of stem bore in pump body (19). Replace if greater than 0.3755 inch (9.5 mm).

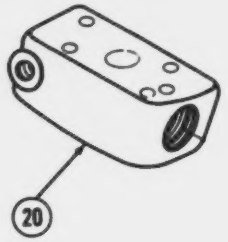
4 Measure inside diameter of plunger (26) bore in pump body (19). Replace if greater than 0.9850 inch (25.0 mm).

5 Measure outside diameter of plunger (26). Replace if less than 0.9830 inch (25.0 mm).









6 Replace valve plate (20) if fractured, cracked or damaged.

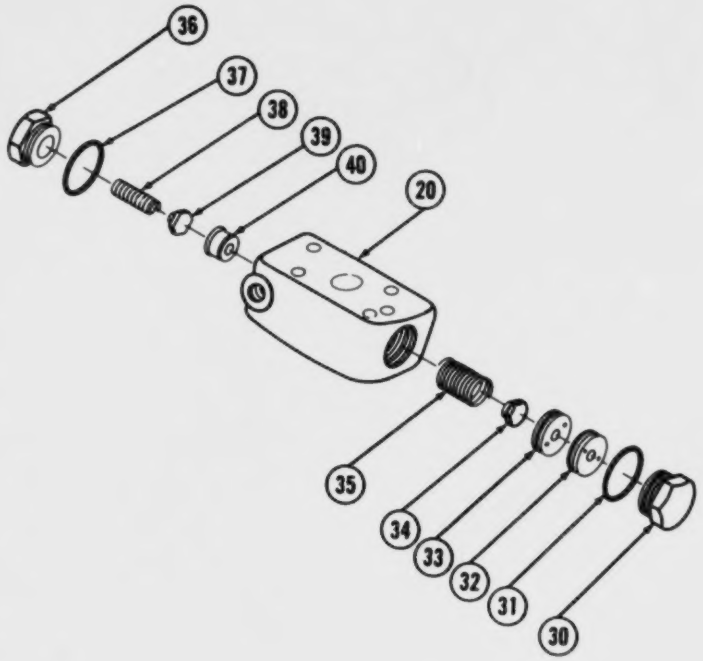
7 Replace outlet tube (8) and inlet tube (11) if bent, crimped, cracked or damaged.

8 Inspect collar assembly of tee (13) to be sure holes are clear. Blow low pressure air through tee (13) to remove all foreign matter. Replace if damaged or obstructed.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-2. LUBRICATING PUMP AND LINES — Continued

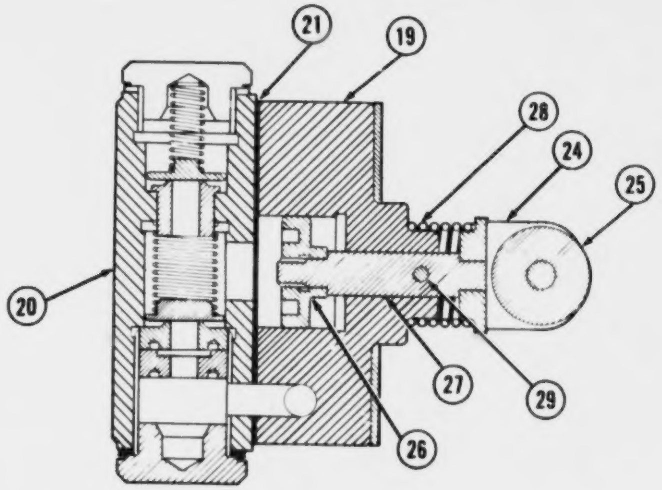
d. Assembly

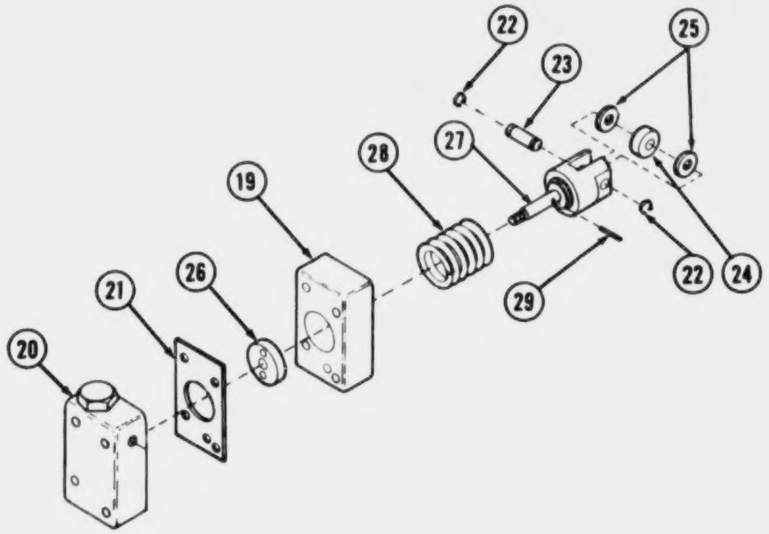


1 Place pump plate (20) in a soft-jawed vise.

2 Install new outlet valve seat (40), new outlet valve (39), new spring (38), new gasket (37) and new upper plug (36) in valve plate (20).

3 Install new spring (35), new inlet valve (34), new inlet valve seat (33), new retaining ring (32), new gasket (31) and new lower plug (30) in pump plate (20).





4 Press pin (29) into stem assembly (27). Be sure pin is centered in stem.

5 Place new spring (28) on pump body (19). Insert stem assembly (27) through new spring (28) and pump body (19), alining pin (29) with slot in pump body (19).

6 Apply force to stem assembly (27) to compress new spring (28) and thread plunger (26) onto stem of stem assembly (27). Turn plunger (26) until it is completely seated on shoulder of stem assembly (27). Lightly peen stem assembly (27) thread in one place to lock plunger (26) to stem.

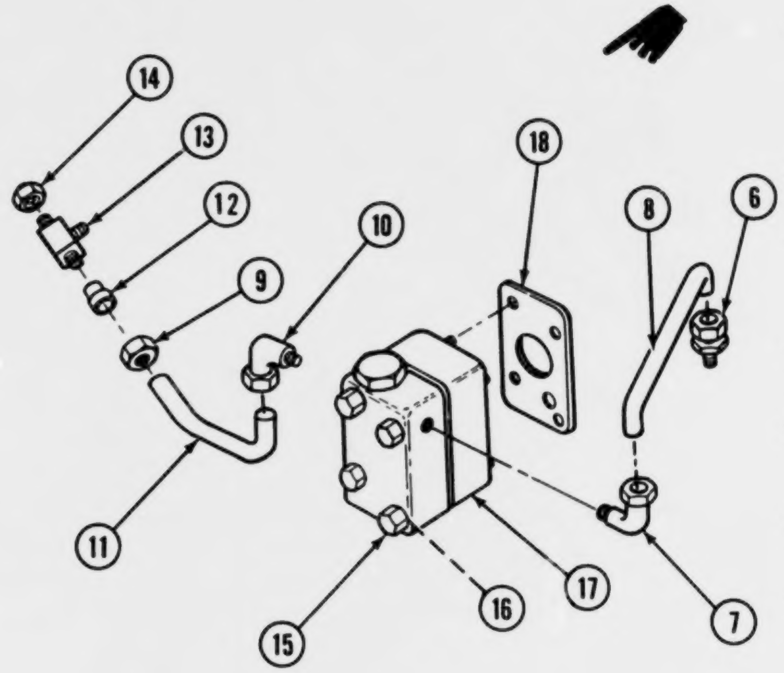
7 Install two flat washers (25), cam roller (24) and cam roller grooved pin (23) in clevis of stem assembly (27). Secure cam roller grooved pin (23) with two new retaining rings (22).

8 Place a new gasket (21) between pump body (19) and pump plate (20).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-2. LUBRICATING PUMP AND LINES – Continued

e. Installation



1 Holding lubricating pump assembly (17) together by hand, install four new lock washers (16) and four cap screws (15) through lubricating pump assembly (17).

2 Place a new gasket (18) over cap screws (15).

3 Install lubricating pump assembly (17) and new gasket (18) on upper housing of traversing mechanism assembly.

4 Install elbow (10) on lubricating pump assembly (17).

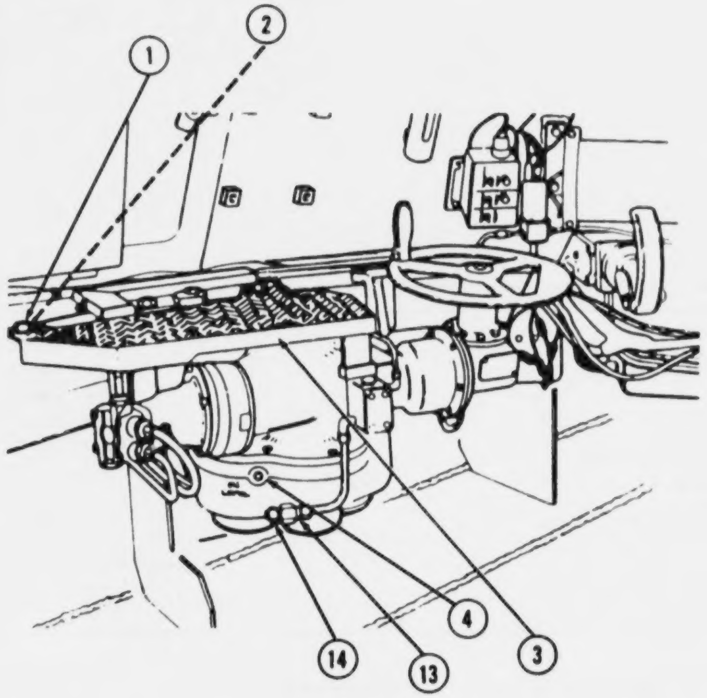
5 Install tee (13) on lower housing of traversing mechanism assembly.

6 Install sleeve (12), compression hex nut (9) and inlet tube (11).

7 Install adapter (6) on top housing of traversing mechanism assembly.

8 Install elbow (7) on lubricating pump assembly (17).

9 Install outlet tube (8).



10 Add approximately four quarts of lubricating oil (Item 15, App. C) or until oil is level with bottom of oil level check and fill hole plug (4).

11 Install fill hole plug (4) and tighten.

12 Traverse cab manually or by power until a steady stream of oil comes out of unplugged branch of tee (13). This will purge any air from the lines.

13 Install plug (14) on tee (13).

14 Install step plate (3), two flat washers (2) and two screws (1).

TRAVERSING MECHANISM ASSEMBLY — Continued

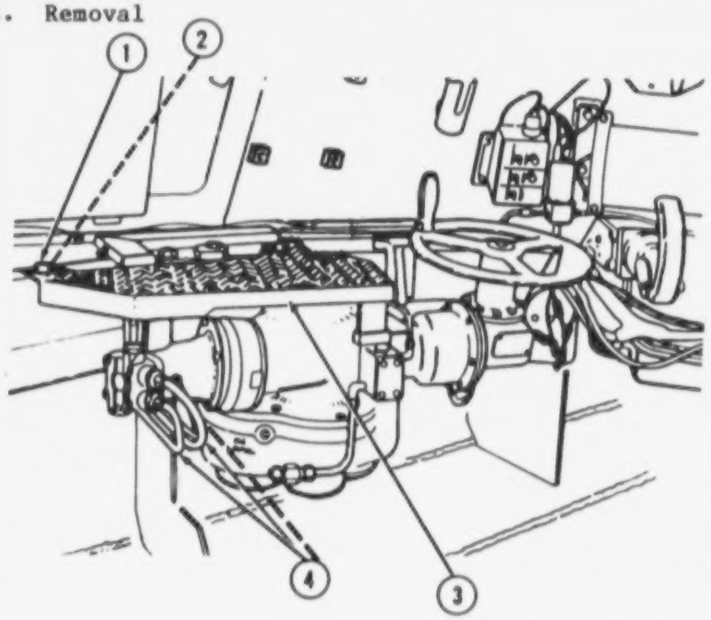
9-3. RELIEF VALVE ASSEMBLY

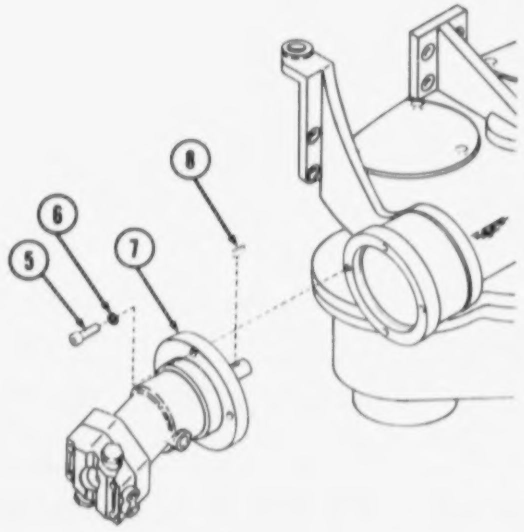
This task covers: a. Removal b. Disassembly c. Inspection d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts	Special Tools	Personnel Required
Hydraulic motor parts repair kit P/N 5703502	Small stand with 2-3/16 inch (55.6 mm) hole in top	2
Dry cleaning solvent PD 680 (Item 7, App. C)	Profilometer (if available)	
Lock washers		
Lock wire		
C-washer		
Preformed packings		

a. Removal





NOTE

Relieve hydraulic system pressure before removing the relief valve assembly (ref. TM 9-2350-311-20-2).

1 Remove two cap screws (1), two flat washers (2) and step plate (3).

2 Place container under two hydraulic lines (4) to catch any oil leakage.

3 Disconnect two hydraulic lines (4) at the relief valve assembly and one hydraulic line at hydraulic motor assembly (7) (ref. TM 9-2350-311-20-2).

4 Remove four socket head cap screws (5), four lock washers (6) and hydraulic motor assembly (7) from adapter on traversing mechanism housing. Discard four lock washers (6).

5 Remove key (8) from motor shaft and save for use during installation.

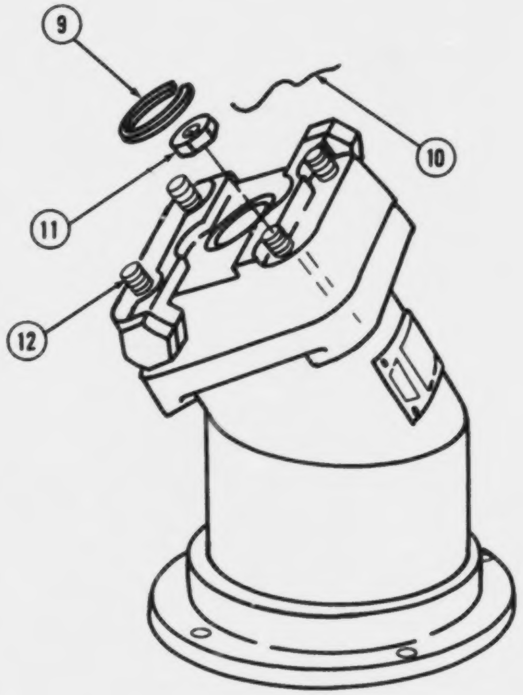
TRAVERSING MECHANISM ASSEMBLY — Continued

9-3. RELIEF VALVE ASSEMBLY — Continued

a. Removal-Continued

NOTE

- The exterior of the relief valve and hydraulic motor assembly must be completely clean and dry before beginning removal of the relief valve plate assembly.
- Removal of the relief valve plate assembly must be performed only in a dust-free room with a filtered air supply. Personnel should coat hands with clean hydraulic fluid when handling valve plate assembly.
- Because of the extremely smooth finish on the inside face of the relief valve plate, removal of the plate from the hydraulic motor housing is not recommended unless it is necessary to service the internal parts of the motor. To service the relief valve parts, leave the relief valve plate attached to the motor housing and proceed to disassembly procedures (ref. page 9-22).



6 Place motor assembly flange end down on a small stand with 2-3/16 inch (55.6 mm) hole, inserting the end of the motor shaft through the hole in the top of the stand.

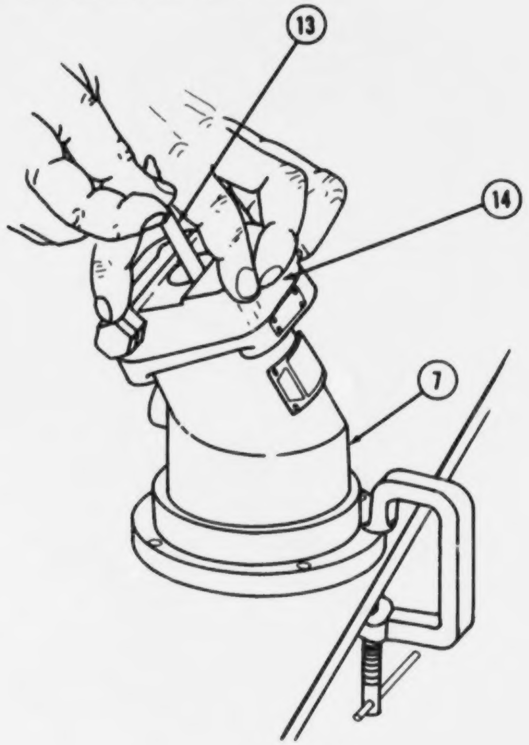
7 Remove and discard C-washer (9) and lock wire (10) from relief valve assembly.

8 Remove four hex nuts (11) from four studs (12).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-3. RELIEF VALVE ASSEMBLY — Continued

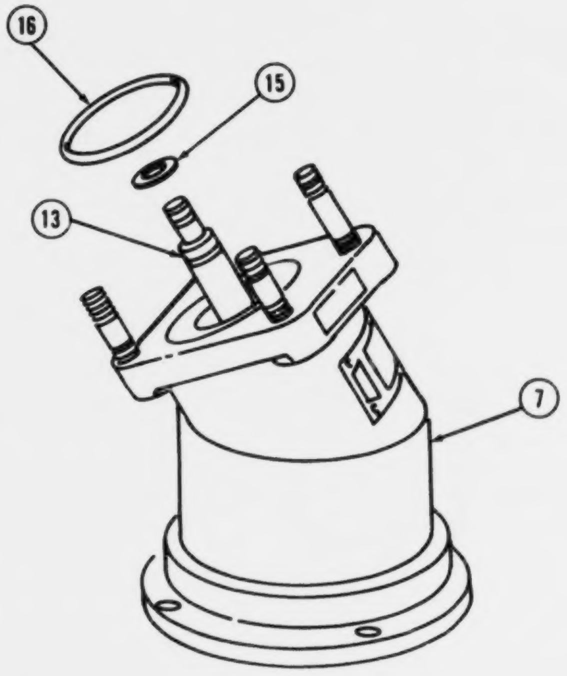
a. Removal-Continued



NOTE

- The highly finished inside face of the relief valve plate assembly must not be touched by bare hands. If valve plate must be stored or shipped, place finished face down on lint-free cloths saturated with clean hydraulic fluid and wrap in a plastic bag. Seal tightly to prevent the accumulation of moisture or dust.
- The cylinder pin and bearing must be held in place while the relief valve plate assembly is removed. This prevents the cylinder block of the hydraulic motor (not visible in illustration) from adhering to the relief valve plate and being pulled from the pistons.

9 Exert a downward force with one hand on pin and bearing (13) while holding valve plate assembly (14) with the other. Have a helper hold housing of hydraulic motor assembly (7) firmly against top of stand. Pull up relief valve plate assembly (14) to remove it, all the while pressing down on pin and bearing (13).



NOTE

Do not remove the four studs from the motor assembly housing (ref. page 9-24.)

10 Remove preformed packing (15) from pin and bearing (13). Discard preformed packing (15).

11 Remove preformed packing (16) from groove in face of housing of hydraulic motor assembly (7). Discard preformed packing (16).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-3. RELIEF VALVE ASSEMBLY — Continued

b. Disassembly

WARNING

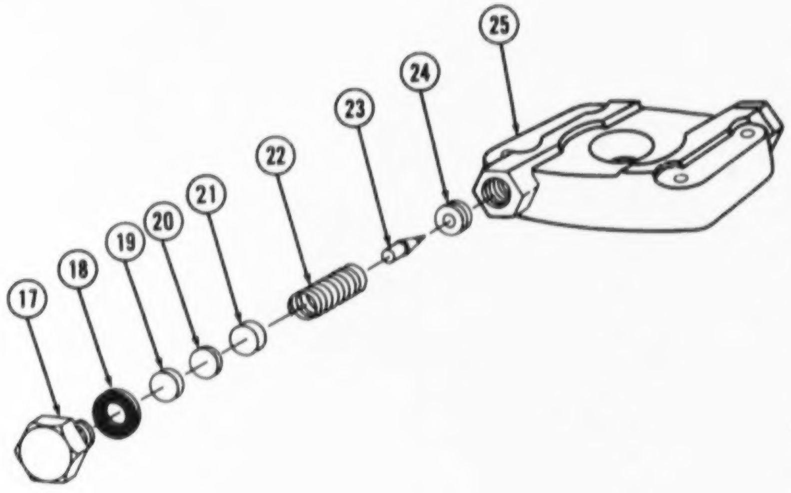
Spring is under a high compressive preload of 143 pounds (65 kilograms). Wear eye protection and make provision to contain parts when preload is released during disassembly by removal of plug.

CAUTION

To avoid damaging the finished inside surface of the valve plate, disassemble the relief valves without removing the valve plate from the hydraulic motor housing.

NOTE

There are two relief valves in the valve plate assembly. The procedure that follows applies equally to both.



1 Remove plug (17).

2 Remove and discard preformed packing (18).

NOTE

Identify quantities and locations of solid plain discs (if present) for use again during assembly.

3 Remove discs (19 and 20), if present. Save discs (19 and 20) for reuse in assembly.

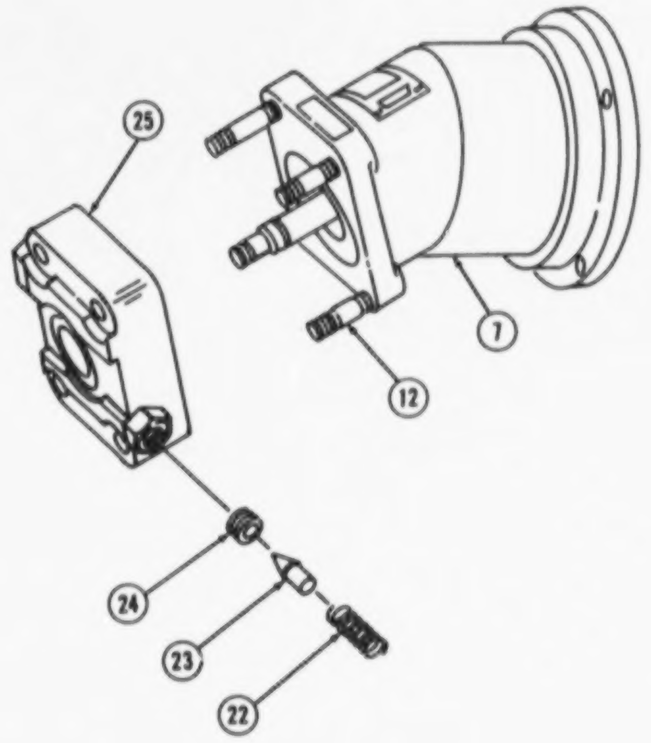
4 Remove spacer (21), spring (22), piston (23) and valve seat (24) from valve plate (25).

5 Repeat steps 1 thru 4 for remaining relief valve.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-3. RELIEF VALVE ASSEMBLY – Continued

c. Inspection



1 Inspect piston (23) and valve seat (24) for nicks, cracks, sharp chamfer or any wear. Replace piston (23) and valve seat (24) as a set.

2 Measure free length of spring (22). Replace if less than 1.24 inches (31.5 mm).

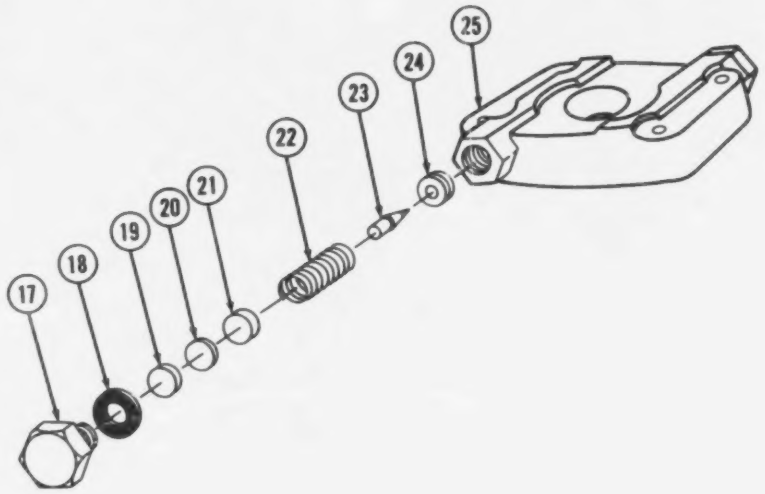
3 Inspect four studs (12). If four studs (12) are missing, bent, broken or have damaged threads, replace as required.

4 Inspect valve plate (25) for any visual sign of wear on the smooth, finished inside surface. This surface will be highly polished and appear to be mirror-like.

5 Make a magnetic particle inspection of the valve plate (25) (ref. MIL-I-6868).

6 If a profilometer is available, check the flatness of the finished surface of the valve plate (25). The surface must be flat within 0.000033 inch (0.000838 mm) (three light bands). Replace entire relief valve assembly if valve plate (25) is not flat to this specification. If profilometer is not available, check manually.

d. Assembly



NOTE

The following procedure is for one of the relief valves in the relief valve assembly. The other relief valve is identical.

1 Install valve seat (24) and piston (23) in valve plate (25).

2 Install new preformed packing (18) on plug (17).

3 Position spring (22) on valve seat (24).

4 Install discs (19 and 20), if previously used, and spacer (21) on plug (17).

WARNING

Force required to compress spring is 143 pounds (65 kilograms). Wear eye protection and make provision to contain parts when compressing springs.

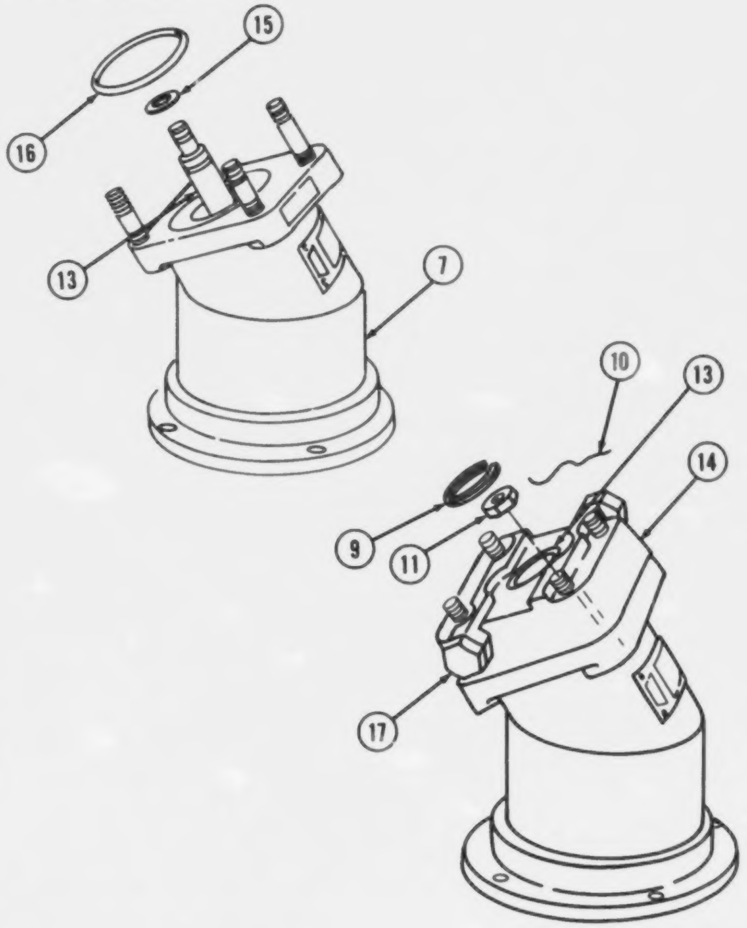
5 Install plug (17), with discs (19 and 20) and spacer (21), over end of spring (22). Compress spring (22) and thread plug (17) completely into valve plate (25).

6 Repeat steps 1 thru 5 for remaining relief valve.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-3. RELIEF VALVE ASSEMBLY — Continued

e. Installation



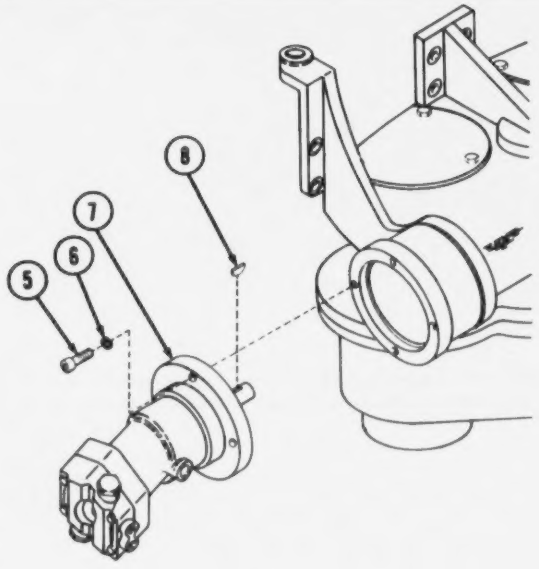
1 Install new preformed packing (15) in groove on pin and bearing (13).

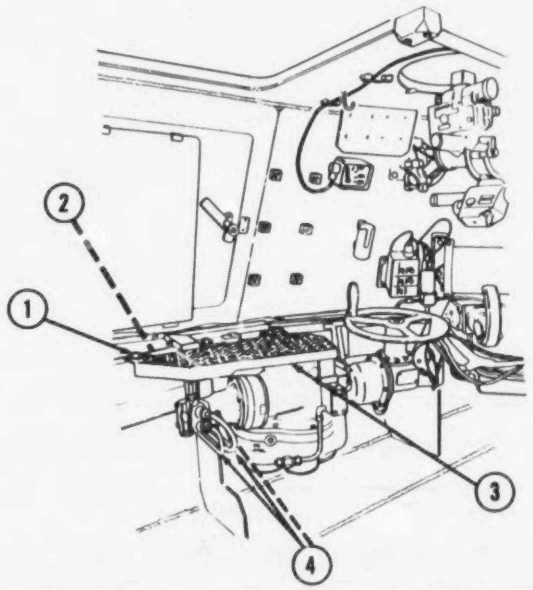
2 Install new preformed packing (16) in groove in face of housing of hydraulic motor assembly (7).

3 Install relief valve plate assembly (14) onto housing of hydraulic motor assembly (7). Secure with four hex nuts (11). Torque four hex nuts (11) to 18-20 ft-lbs (24-27 N·m).

4 Secure four hex nuts (11) and two plugs (17) of relief valve assembly with one continuous length of new lock wire (10).

5 Install new C-washer (9) on pin and bearing (13).





6 Install key (8) in keyway of motor shaft.

7 Aline key (8) with keyway in shaft in traversing mechanism assembly housing. Install hydraulic motor assembly (7). Secure hydraulic motor assembly (7) with four new lock washers (6) and four socket head cap screws (5).

8 Connect two hydraulic lines (4) to relief valve assembly and one hydraulic line to hydraulic motor assembly (7) (ref. TM 9-2350-311-20-2).

9 Install step cover (3) and secure with two flat washers (2) and two cap screws (1).

10 Check hydraulic system fluid level (ref. LO 9-2350-311-12).

11 Charge and bleed hydraulic system (ref. TM 9-2350-311-20-2).

TRAVERSING MECHANISM ASSEMBLY — Continued

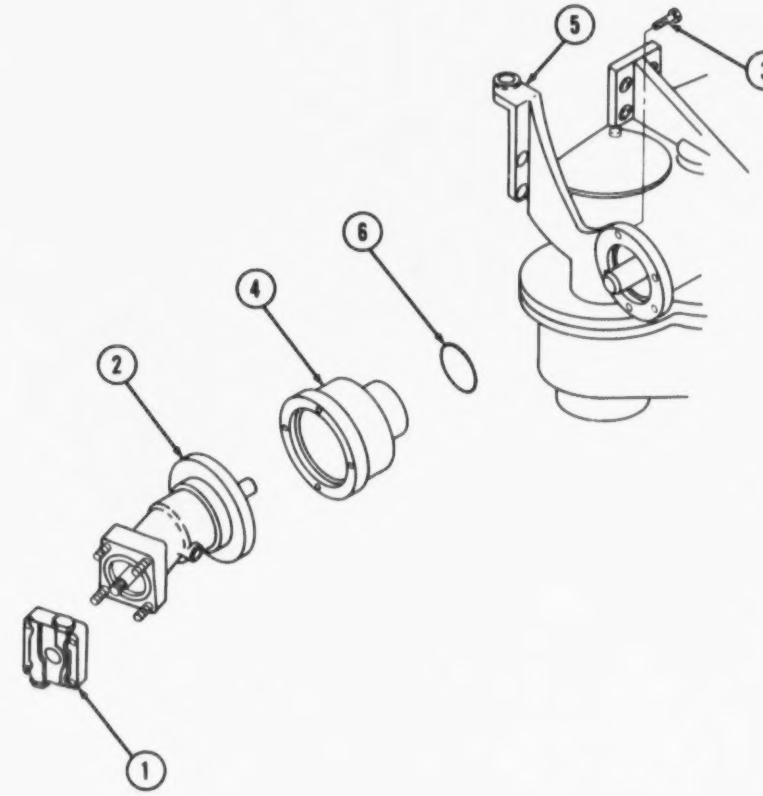
9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER

This task covers: a. Removal b. Disassembly c. Inspection d. Assembly e. Installation

INITIAL SET-UP

Material/Parts	Special Tools
Hydraulic motor parts repair kit P/N 5703502	Arbor press
Clean hard wood blocks, 8 x 8 x 3 inches	Electric oven
Dry cleaning solvent PD 680 (Item 7, App. C)	Small stand with 2-3/16 inch (55.6 mm) hole in top
Lock wire	Fabricated plastic protective shield, 2 inches (50.8 mm) outside diameter x 3/8 inch (9.5 mm) inside diameter
Grease, automotive and artillery (Item 9, App. C)	
Lubricating Oil (Item 17, App. C)	
Bearings	

a. Removal



NOTE

Hydraulic motor assembly and adapter can be removed from traverse mechanism mounted in cab (ref. page 9-6).

1 Remove relief valve assembly (1) and hydraulic motor assembly (2) (ref. page 9-17) from adapter (4).

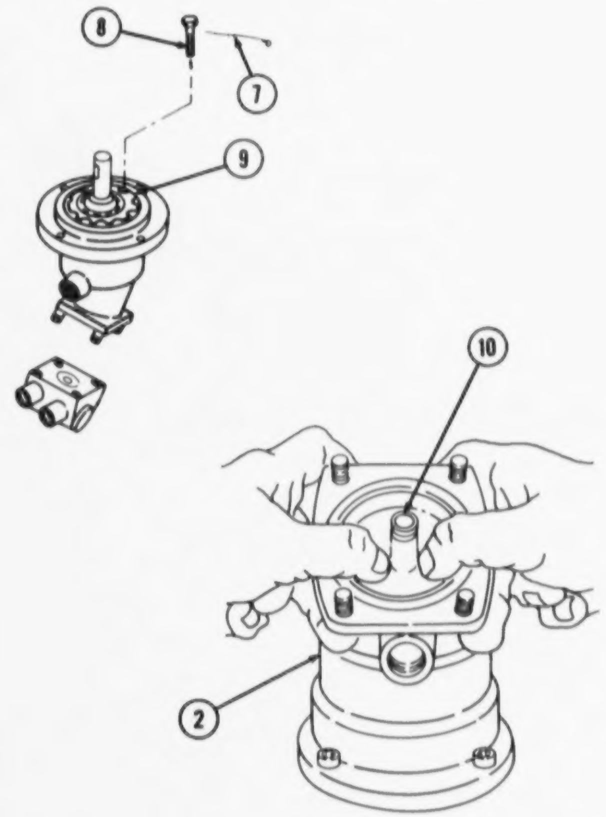
2 Remove five hex head cap screws (3) and separate adapter (4) from traversing mechanism upper housing (5).

3 Remove, tag, and save shim(s) (6) for reuse during assembly.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER — Continued

b. Disassembly



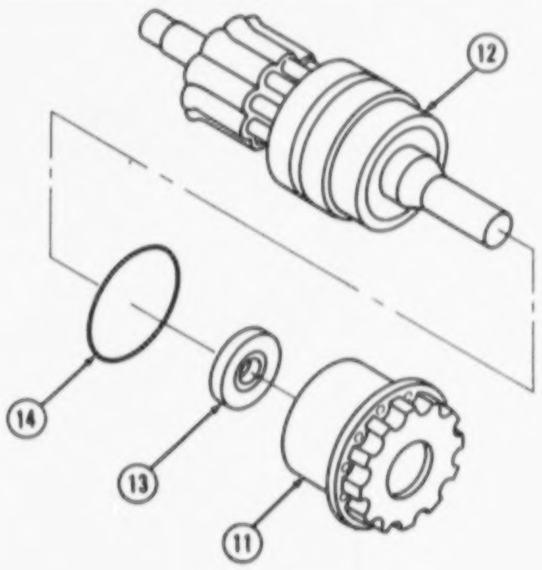
1 Remove and discard lock wire (7) from 12 socket head cap screws (8).

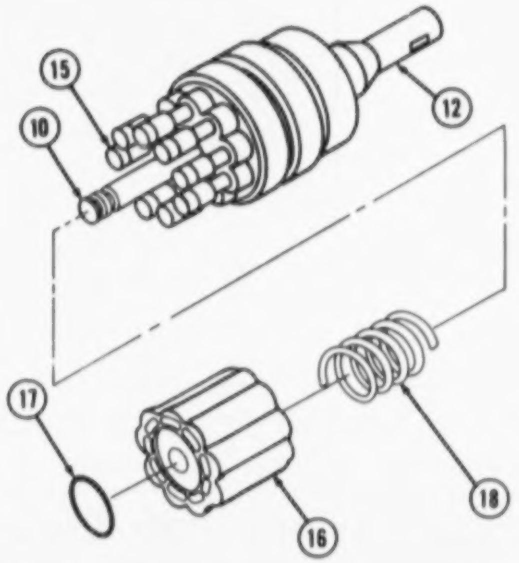
2 Remove 12 socket head cap screws (8) from seal and bearing retainer assembly (9).

3 Fabricate, from scrap plastic, a shield 2 inches (50.8 mm) outside diameter by 3/8 inch (9.5 mm) inside diameter. Place shield over the end of pin and bearing (10) to cover the surface of the cylinder block (16).

4 Place the hydraulic motor assembly (2) round flange end down on a small stand with a 2-3/16 inch (55.6 mm) hole in the top.

5 With the plastic protective shield in place, grasp hydraulic motor assembly (2) with the fingers of both hands while pressing against shield with thumbs. Lift housing of hydraulic motor assembly (2) from the internal rotating group of the housing as it is removed. Be careful not to get the parts misalined and jammed, or they will be damaged.





CAUTION

Do not allow the bearings of the shaft assembly to become misalined or jammed in retainer.

6 Remove seal and bearing retainer (11) from shaft assembly (12). Use care to prevent the parts of the shaft assembly (12) from separating.

7 Remove and discard shaft seal (13) from seal and bearing retainer (11).

8 Remove preformed packing (14) from its groove on the outside of seal and bearing retainer (11). Discard preformed packing (14).

CAUTION

Do not allow pistons to strike one another when removing cylinder block.

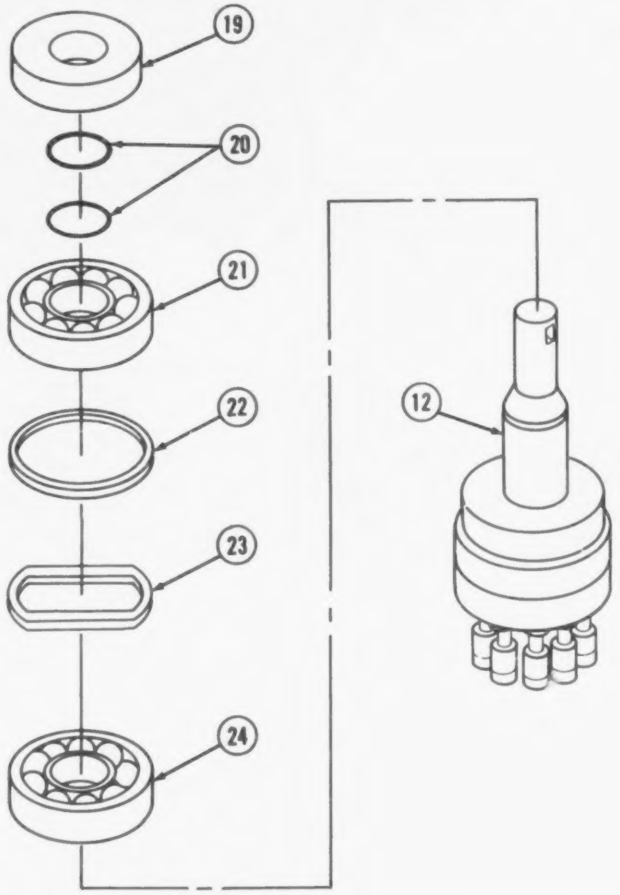
9 Remove preformed packing (17) from groove nearest cylinder block (16) on pin and bearing (10). Do not remove pin and bearing (10). Discard preformed packing (17).

10 Remove cylinder block (16) from pistons (15). Remove spring (18) from shaft assembly (12).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER — Continued

b. Disassembly-Continued

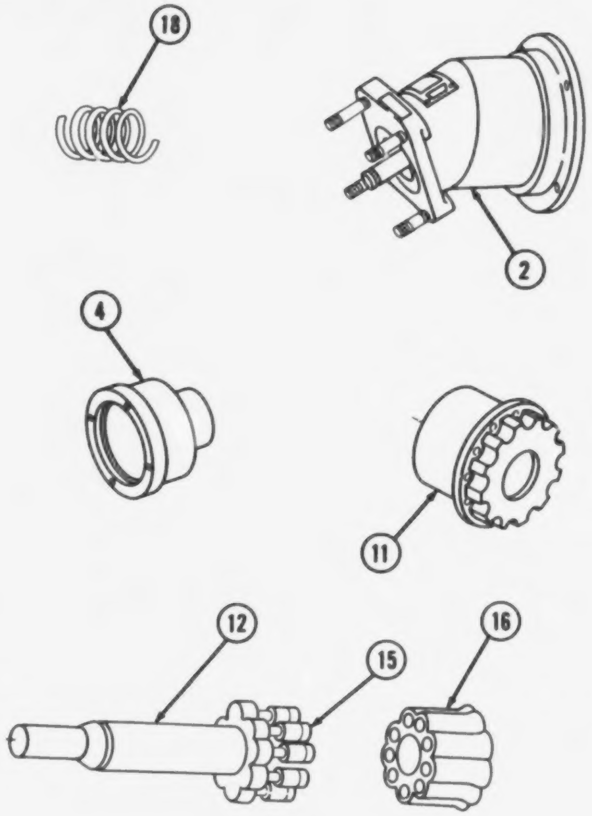


CAUTION

When removing bearing, hold shaft assembly from below to prevent pistons from falling. Do not allow pistons to swing from side to side, or strike one another.

11 Using an arbor press, press shaft assembly (12) downward to remove bearing (19), two spacer rings (20), bearing (21), spacer ring (22), wave washer (23) and bearing (24). Discard bearings (19, 21 and 24).

c. Inspection



1 Replace complete shaft assembly (12) if piston (15) is cracked, nicked, burred or if outside diameter is less than 0.408 inch (10.4 mm).

2 Replace complete shaft assembly (12) if piston (15) slides roughly into cylinder block (16) or if piston bores in cylinder block (16) are greater than 0.4066 inch (10.3 mm).

3 Replace complete shaft assembly (12) if shaft is scored, broken, cracked or distorted or if wave washer (23) is broken, cracked or flattened.

4 Replace spring (18) if free length is less than 0.880 inch (22.6 mm), or if cracked, broken or distorted.

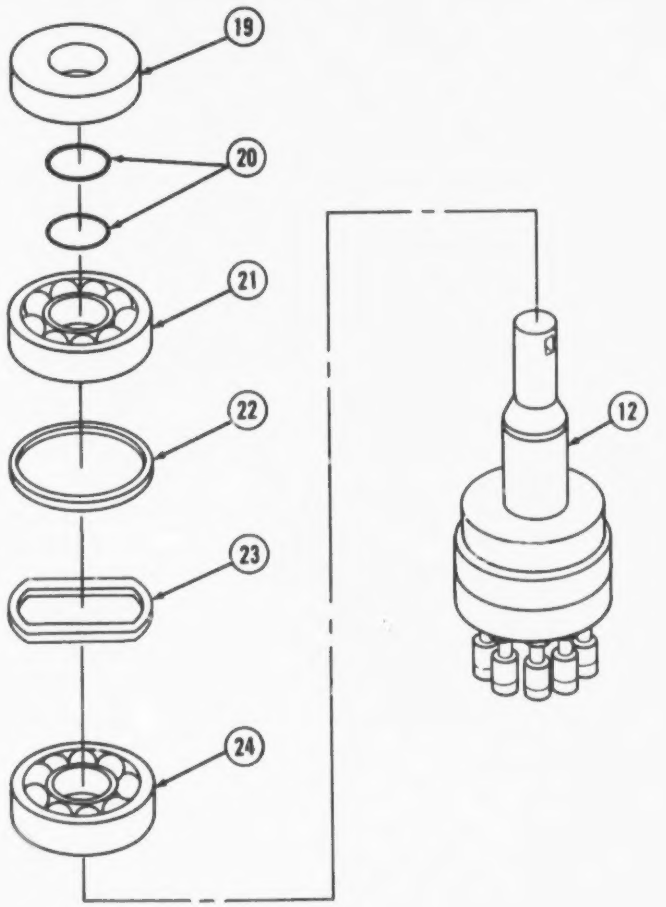
5 Replace adapter (4) if cracked, broken or distorted.

6 Replace complete hydraulic motor assembly (2) if seal and bearing retainer (11), housing or cylinder block (16) are cracked, broken or distorted.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER — Continued

d. Assembly



1 Heat new bearings (19, 21 and 24) for one hour in an electric oven set at 250°F (107°C) to 300°F (135°C).

NOTE

Speed is essential when installing bearings to prevent the shaft assembly from heating up and causing the bearings to bind during installation.

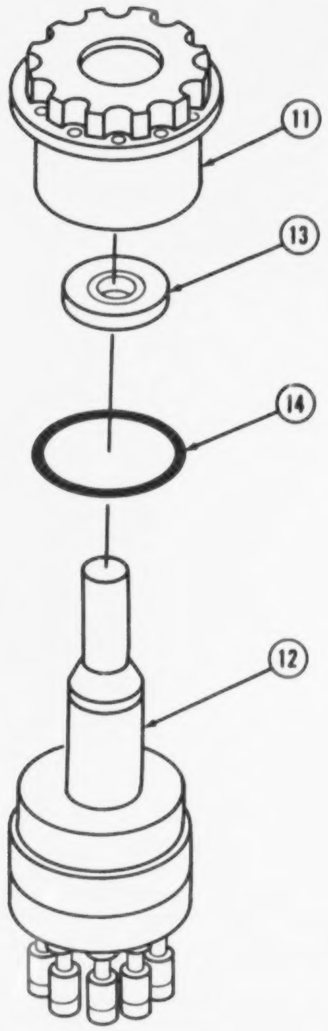
2 Remove bearing (24) from oven and quickly press it onto shaft assembly (12). Allow all parts to cool to room temperature.

3 Install wave washer (23) and spacer ring (22) onto top of bearing (24).

4 Remove bearing (21) from oven and quickly press into place on shaft assembly (12). Allow all parts to cool to room temperature.

5 Install two spacer rings (20) on top of bearing (21).

6 Remove bearing (19) from oven and quickly press into place on shaft assembly (12). Allow all parts to cool to room temperature.



7 Install new preformed packing (14) into groove around outside of seal and bearing retainer (11).

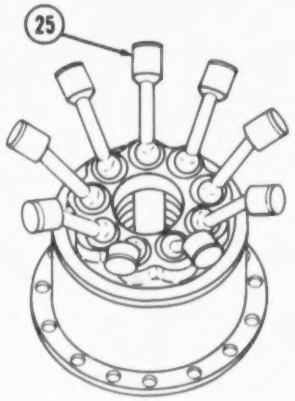
8 Install new shaft seal (13), high pressure side first, into seal and bearing retainer (11).

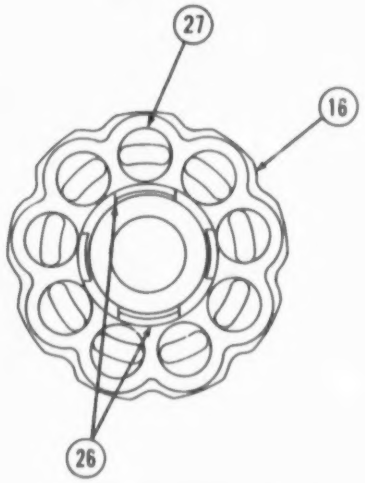
9 Install seal and bearing retainer (11) over bearings on shaft assembly (12).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER — Continued

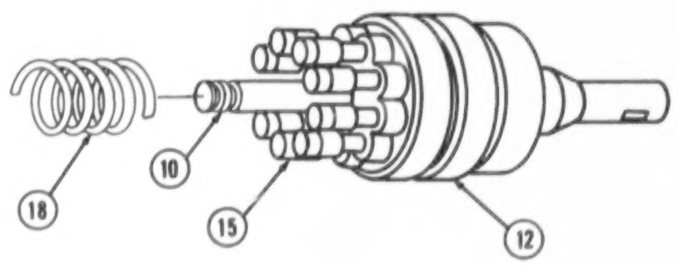
d. Assembly-Continued

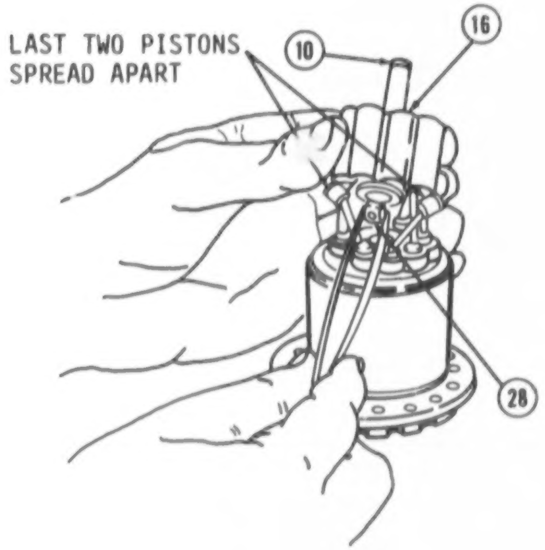




10 Locate the Number One piston (25). It is the only piston directly in line with both two slots (26) of the shaft universal link retainer (link assembly is not shown in illustration in order to depict slots more clearly).

11 Locate Number One cylinder bore (27). It is the only one in line with both slots (26) of the shaft universal link retainer in the cylinder block (16).




LAST TWO PISTONS SPREAD APART
10
16
28

12 Place spring (18) over pin and bearing (10).

13 Hold cylinder block (16) over pistons (15) and shaft assembly (12) and insert Number One piston (25) into Number One cylinder bore (27). Continue to insert pistons (15) into their bores, working alternately at either side of Number One piston (25). As pistons (15) are being inserted, continue to push cylinder block (16) down onto Number One piston (25), leaving just enough clearance to insert the next piston (15).

14 When only two pistons (15) remain to be inserted, the cylinder block (16) will be fully depressed on Number One piston (25) with the sixth and seventh pistons (15) inserted less than one-third of their length into the cylinder block (16).

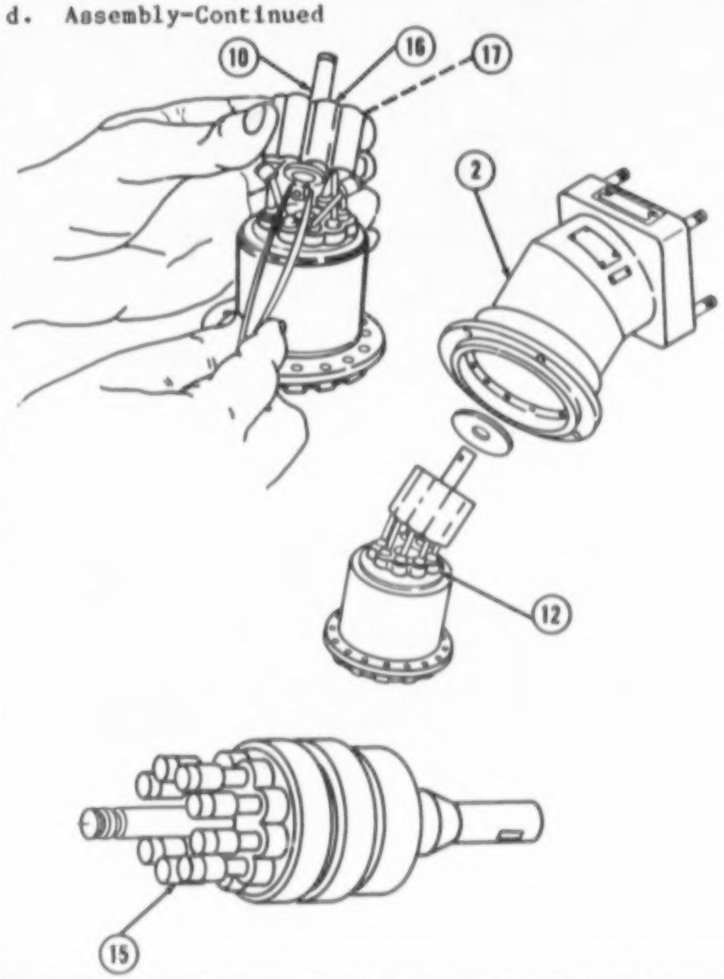
15 Use long tweezers to grasp the universal link knuckle (28) closest to the Number One piston (25). Guide the universal link knuckle (28) carefully into the slot in the universal link retainer in the cylinder block (16).

16 Grasp the remaining knuckle with the tweezers. This knuckle is near the two pistons (15) not yet inserted. Tip the cylinder block (16) slowly back to guide the knuckle into the remaining slot in the cylinder block (16).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-4. HYDRAULIC MOTOR ASSEMBLY AND ADAPTER – Continued

d. Assembly-Continued



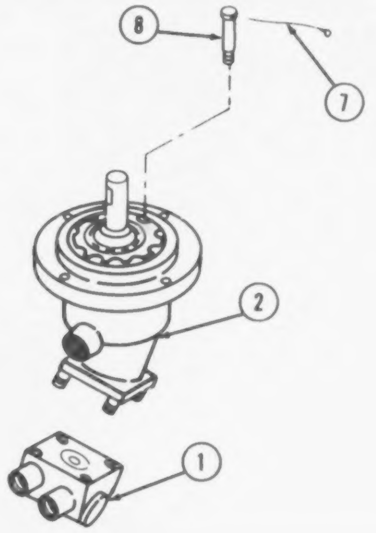
17 Aline the two remaining free pistons (15) with their bores in the cylinder block (16).

18 Continue carefully and slowly to tip the cylinder block (16) towards the full upright position until all pistons (15) are fully inserted.

19 Test the assembled shaft assembly (12) for freedom of movement by pushing the cylinder block (16) down and allowing it to return to its original position. The action of its return should be smooth and springy. Also rotate the cylinder block (16) while holding the flange of the shaft assembly (12) firmly. This action should be smooth without binding at any point.

20 Install a new preformed packing (17) in the groove nearest the cylinder block (16) on pin and bearing (10).

21 Place fabricated plastic shield over cylinder block (16). Carefully lower housing of hydraulic motor assembly (2) over shaft assembly (12) while guiding cylinder block (16) along angle of housing. When housing reaches seal and bearing retainer assembly (9) (ref. page 9-30), make sure it is squarely over seal and bearing retainer assembly (9) to avoid misalining and jamming parts inside.



22 Install 12 socket head cap screws (8) and torque to 12 in-lbs (1.4 N·m).

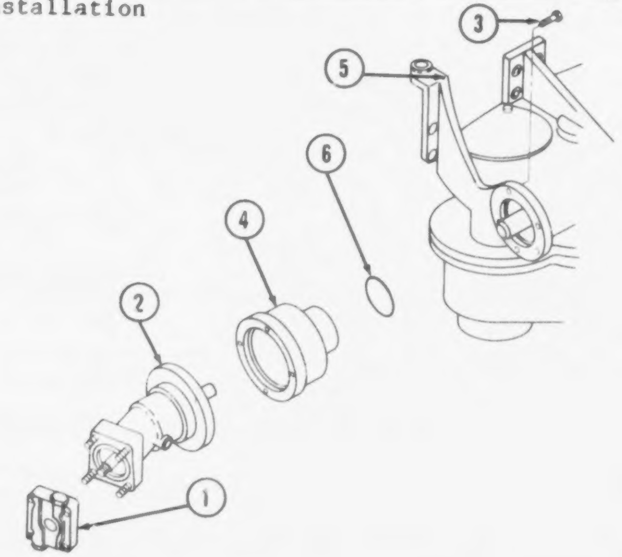
23 Secure 12 socket head cap screws (8) with new lock wire (7).

24 Install relief valve assembly (1) (ref. page 9-27).

NOTE

If possible, send hydraulic motor and relief valve assembly to be tested before installation.

e. Installation



1 Install original shim(s) (6) retained from removal of adapter (4) to traversing mechanism upper housing (5) with five hex head cap screws (3).

2 Install hydraulic motor assembly (2) and relief valve assembly (1) to adapter (4) (ref. page 9-27).

3 Fill, charge and bleed hydraulic system (ref. TM 9-2350-311-20-2) if removed from vehicle.

TRAVERSING MECHANISM ASSEMBLY — Continued

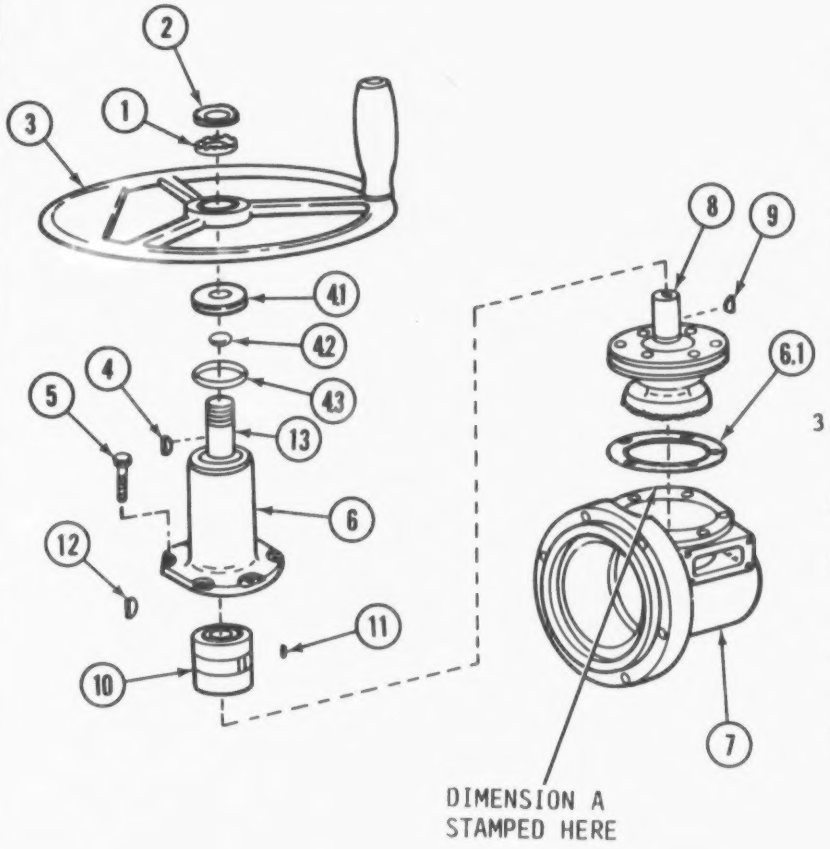
9-5. MANUAL TRAVERSE HANDWHEEL ASSEMBLY AND NO-BACK BEARING

This task covers: a. Removal b. Disassembly c. Assembly d. Installation

INITIAL SET-UP

Materials/Parts	Special Tools
Gaskets	Micrometer, outside
Bearings	Dial indicator
Shim, P/N 11636081	Bearing separator
Grease (Item 9, App. C)	Arbor press
Sealing compound (Item 24.1, App. C)	
Preformed packing	
Seal	

a. Removal



NOTE

Place cab turret lock in locked position (ref. TM 9-2350-311-10) and turn off cab electrical power (ref. TM 9-2350-311-10) before servicing the handwheel assembly.

1 Straighten locking tab of keywasher (1).

2 Remove nut (2) and keywasher (1) from shaft (13).

3 Remove handwheel (3) and upper key (4) from shaft (13).

NOTE

Step 3.1 applies to M109A4 howitzers only.

3.1 Remove cap (4.1); remove and discard preformed packing (4.2), and seal (4.3).

4 Remove six screws (5).

5 Remove upper housing assembly (6) and shim (6.1) from bevel gear housing (7).

6 Note and record dimension "A" stamped on bevel gear housing (7).

7 Remove bevel gear assembly (8) and key (9) from upper housing assembly (6).

NOTE

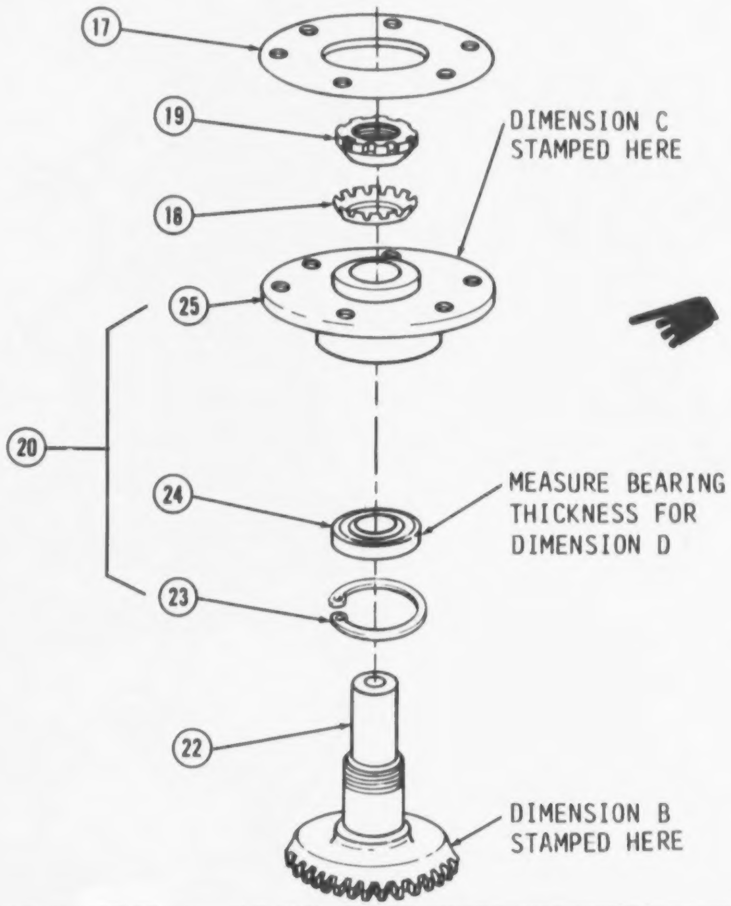
No-back components will separate when removed from shaft and housing.

8 Remove no-back unit (10), pin key (11) and lower key (12) from shaft (13) at upper housing assembly (6).

TRAVERSING MECHANISM ASSEMBLY— Continued

9-5. MANUAL TRAVERSE HANDWHEEL ASSEMBLY AND NO-BACK BEARING – Continued

b. Disassembly


17
19
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18
25
20
24
MEASURE BEARING
THICKNESS FOR
DIMENSION D
23
22
DIMENSION B
STAMPED HERE

1 Remove retaining ring (14) from upper housing assembly (6).

2 Remove bearing (15) and shaft (13) from upper housing assembly (6).

3 Separate bearing (15) from shaft (13).

4 Remove spacer (16) from retainer housing (25) only if replacement is required.

5 Remove and discard gasket (17) from retainer housing (25).

6 Straighten locking tab on keywasher (18).

7 Remove nut (19) and keywasher (18).

8 Remove retainer assembly (20) from bevel gear shaft (22).

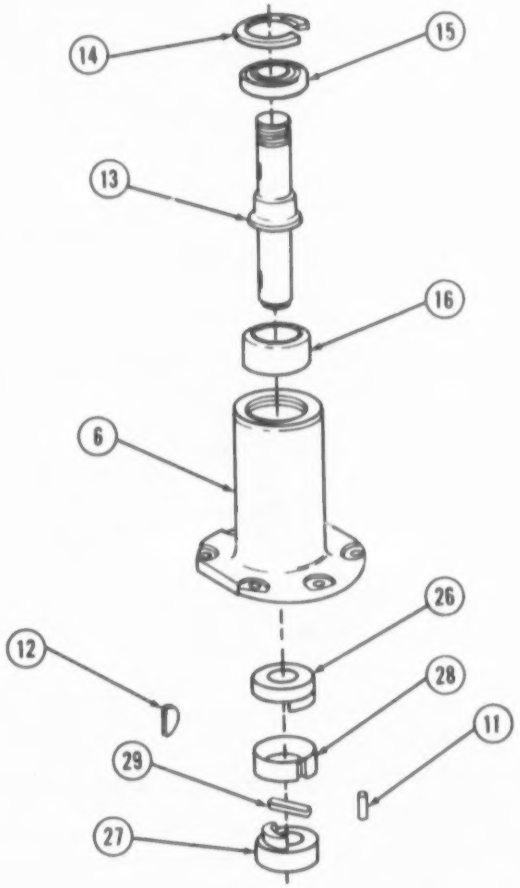
9 Note and record dimension "B" stamped on bevel gear shaft (22).

10 Remove retaining ring (23) and bearing (24) from retainer housing (25).

11 Measure and record thickness of bearing (24) for dimension "D". Also note and record dimension "C" stamped on retainer housing (25).

12 Separate upper drive bearing (26), lower drive bearing (27), lock ring (28), and locking bar spring pack (29).

c. Assembly



NOTE

If spacer was removed, install it prior to installation of bearing and shaft.

1 Assemble shaft (13) and bearing (15) with seal side out.

2 Install retaining ring (14) in upper housing assembly (6).

3 Install lower key (12), spacer (16), upper drive bearing (26), and lock ring (28).

NOTE

Number of springs required in spring pack may vary depending of spring tension.

4 Assemble locking bar spring pack (29) to lower drive bearing (27) and install in lock ring (28).

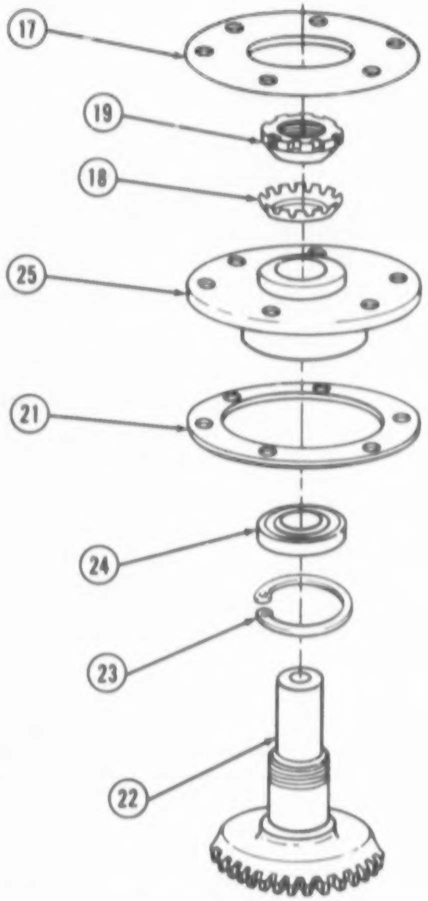
5 Install lower drive bearing (27) to mate with upper drive bearing (26).

5.1 Position pin key (11) in slot of lock ring (28) and carefully install in upper housing assembly (6).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-5. MANUAL TRAVERSE HANDWHEEL ASSEMBLY AND NO-BACK BEARING — Continued

c. Assembly-Continued



6 Pack bearings and coat internal gearing with grease (Item 9, App. C) before assembly.

7 Install bearing (24) and retaining ring (23) in retainer housing (25).

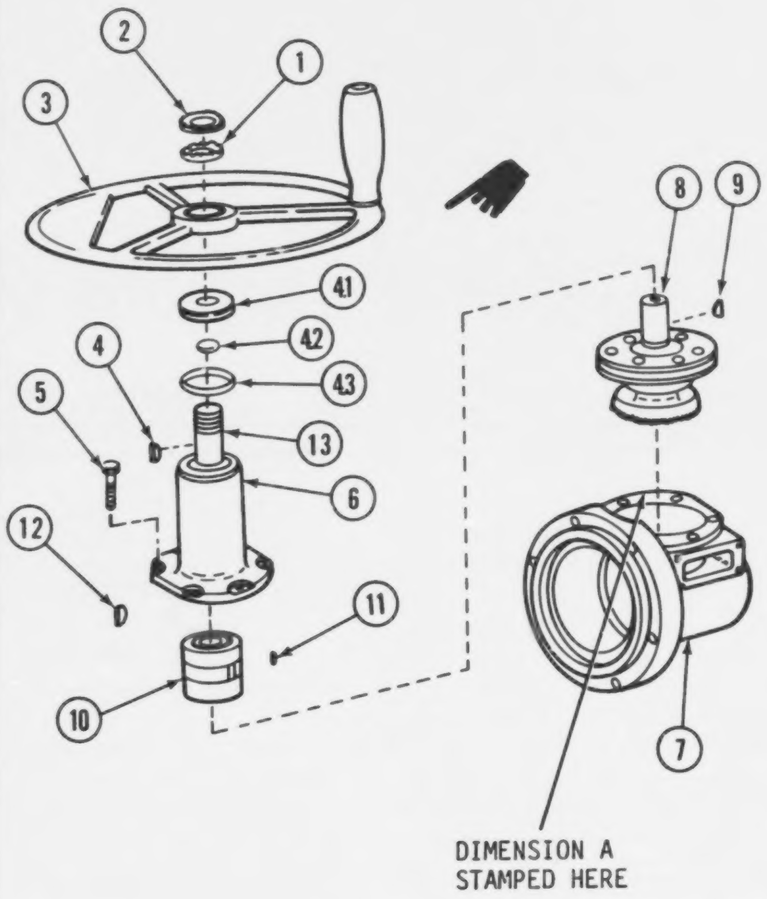
8 Calculate thickness of shim (21). Shim thickness is equal to B + C + D - A (ref. page 9-41 and page 9-42) to give a 0.002- to 0.004-inch (0.05- to 0.10-mm) backlash on M109A2/M109A3 howitzers or a 0.001- to 0.004-inch (0.025- to 0.10-mm) backlash on M109A4 howitzers. Use shim P/N 11636081. Peel off laminations to obtain required thickness.

9 Install keywasher (18) and nut (19) on retainer housing (25).

10 Bend locking tab of keywasher (18) to secure nut (19).

11 Apply sealing compound (Item 24.1, App. C) to gasket (17) and install on retainer housing (25).

d. Installation



1 Install lower key (12), pin key (11) and no-back unit (10) on shaft (13) at upper housing assembly (6).

2 Install key (9) and bevel gear assembly (8) in upper housing assembly (6).

3 Install upper housing assembly (6), with bevel gear assembly (8), on bevel gear housing (7).

4 Install six screws (5).

NOTE

Step 4.1 applies to M109A4 howitzers only.

4.1 Install new seal (4.3), new preformed packing (4.2), and cap (4.1) on shaft (13).

NOTE

To fully seat preformed packing (4.2) in M109A4 traversing mechanisms, use handwheel (3) and nut (2) to tighten cap against preformed packing. Upper key (4) cannot be installed otherwise.

5 Install upper key (4) and handwheel (3) on shaft (13).

6 Install keywasher (1) and nut (2) on shaft (13).

7 Bend locking tab of keywasher (1) into slot of nut (2) to secure nut (2).

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TRAVERSING MECHANISM ASSEMBLY — Continued

9-6. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A2/M109A3)

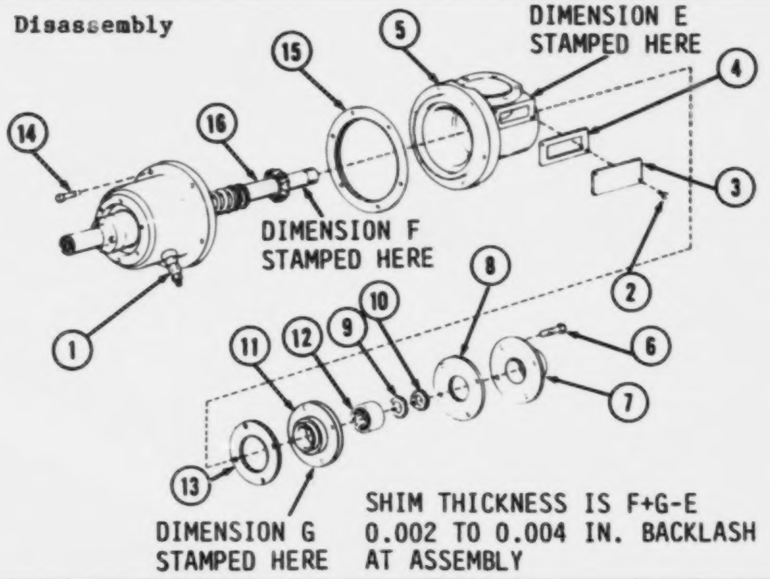
This task covers: a. Disassembly b. Assembly

INITIAL SET-UP

Materials/Parts
Gaskets
Shims
Sealing compound
(Item 20, App. C)
Grease (Item 9, App. C)
Bearings

Special Tools
Torque adapter (Item 1, App. B)

a. Disassembly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16
3
DIMENSION F
STAMPED HERE
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11
12
9
6
7
13
DIMENSION G
STAMPED HERE
SHIM THICKNESS IS F+G-E
0.002 TO 0.004 IN. BACKLASH
AT ASSEMBLY

1 Remove manual traverse clutch brush assembly (1) (ref. page 9-3).

2 Remove manual traverse handwheel assembly (ref. page 9-41).

3 Remove two bolts (2) and access cover (3).

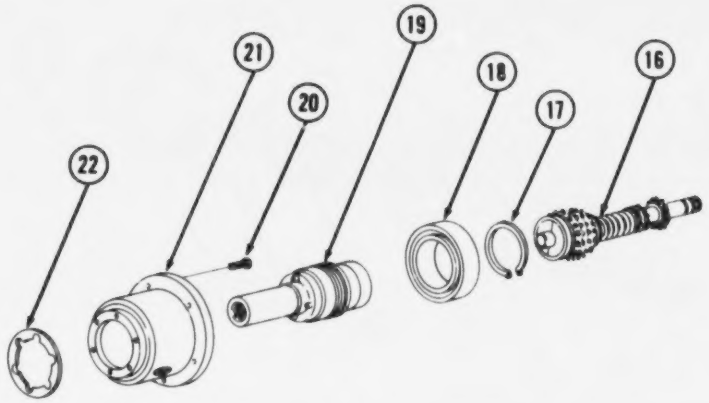
4 Remove and discard gasket (4).

5 Note and record dimension "E" on side of bevel gear housing (5).

6 Remove four hex head cap screws (6) and access cover (7).

7 Remove and discard gasket (8).

8 Bend locking tab on keywasher (9) to disengage keywasher (9) from nut (10).



9 Remove nut (10) and keywasher (9) from gearshaft assembly (16).

10 Remove retaining plate (11) and bearing (12) from gearshaft assembly (16). Discard bearing (12). Support end of gearshaft assembly (16).

11 Note and record dimension "G" stamped on retaining plate (11).

12 Remove shim (13) and save for reuse during assembly.

13 Remove six socket head cap screws (14) and bevel gear housing (5). Support gearshaft assembly (16).

14 Remove and discard gasket (15).

15 Note and record dimension "F" stamped on end of gearshaft assembly (16).

16 Remove retaining ring (17) from groove in shaft of clutch assembly (19).

17 Remove gearshaft assembly (16), bearing (18) and clutch assembly (19) as an assembly unit from housing (21).

18 Remove and discard bearing (18) from clutch assembly (19).

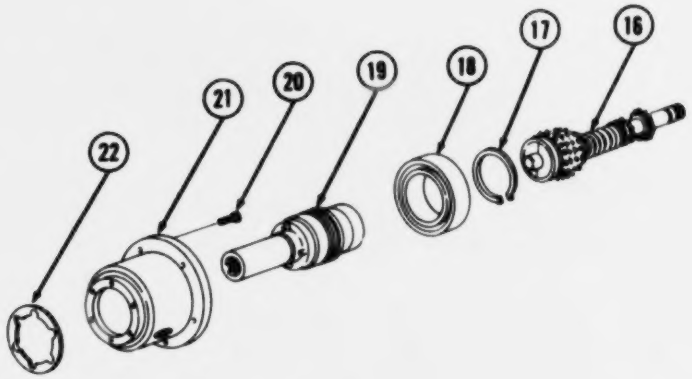
19 Remove six socket head cap screws (20) and housing (21) from traversing mechanism.

20 Remove and discard gasket (22).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-6. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A2/M109A3)—Continued

b. Assembly



1 Set clutch on gearshaft assembly (16) to break away at 250 ± 25 inch-pounds (28.3 ± 2.8 N·m).

2 Pack new bearing (18) and coat internal gearing with grease (Item 9, App. C). Do not apply grease to toothed plates of gearshaft assembly (16).

3 Apply sealing compound (Item 20, App. C) to six socket head cap screws (20).

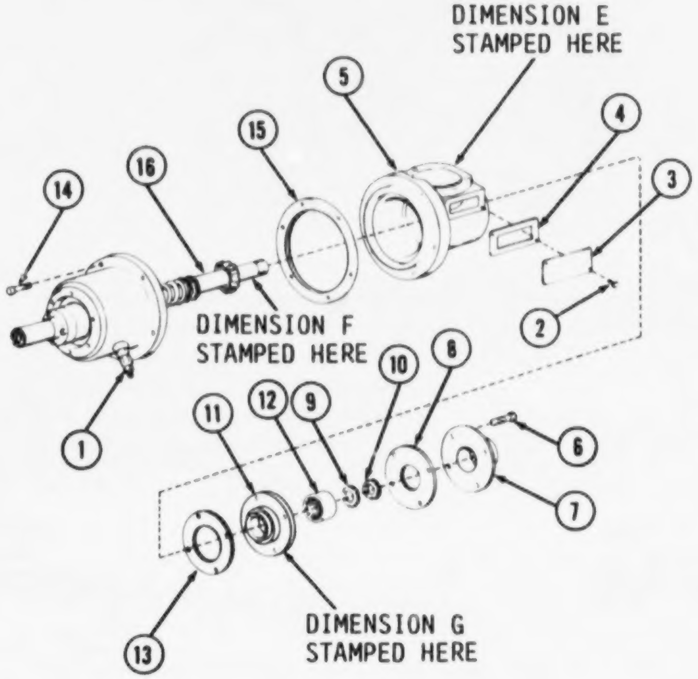
4 Install new gasket (22), housing (21) and secure with six socket head cap screws (20).

5 Install new bearing (18) on clutch assembly (19).

6 Install clutch assembly (19), new bearing (18), and gearshaft assembly (16) as an assembly into housing (21). Support gearshaft assembly (16).

7 Install retaining ring (17) into groove in shaft of clutch assembly (19).

8 Apply sealing compound (Item 20, App. C) to six socket head cap screws (14). Install new gasket (15), bevel gear housing (5) and six socket head cap screws (14).



SHIM THICKNESS IS F+G-E
0.002 TO 0.004 IN. BACKLASH
AT ASSEMBLY

9 Install shim (13). Shim thickness must be equal to Dimensions F + G - E to give 0.002 to 0.004 inch (0.05 to 0.10 mm) backlash at assembly. Use one shim (13) and peel off laminations to obtain proper thickness.

CAUTION

Do not overpack bevel gear housing with grease during assembly. Pack bearings and coat internal gearing with grease (Item 9, App. C).

10 Pack new bearing (12) with grease (Item 9, App. C). Press bearing into retaining plate (11).

11 Install retaining plate (11) with bearing (12) onto gearshaft assembly (16).

12 Install keywasher (9) and nut (10) onto gearshaft assembly (16). Bend locking tab of keywasher (9) into slot in nut (10) to secure it.

13 Install new gasket (8), access cover (7) and four hex head cap screws (6).

14 Check backlash of bevel gears through hole in bevel gear housing (5). Adjust shim (13) thickness until backlash of 0.002 to 0.004 inch (0.05 to 0.10 mm) is obtained.

15 Install new gasket (4), access cover (3), and two bolts (2).

16 Install manual traverse handwheel assembly (ref. page 9-45).

17 Install manual traverse clutch brush assembly (ref. page 9-5).

TRAVERSING MECHANISM ASSEMBLY—Continued

9-6.1. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A4)

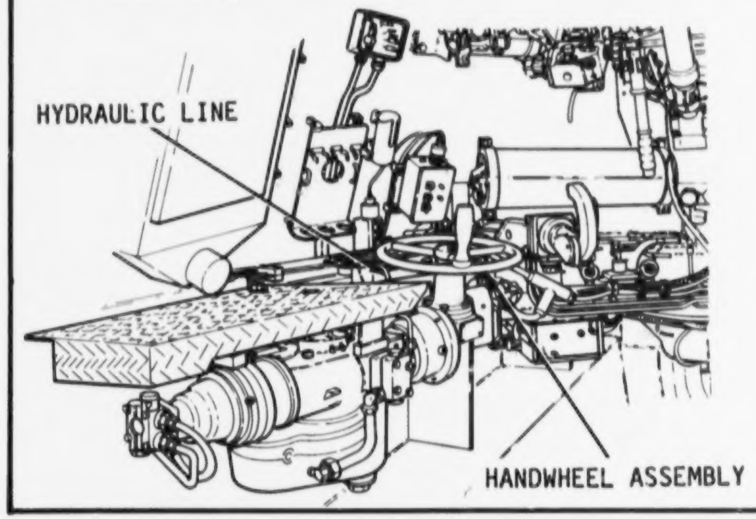
This task covers: a. Disassembly b. Assembly

INITIAL SET-UP

Materials/Parts
Gaskets
Bearings
Seal
Lubricating oil (Item 15, App. C)
Lubricating oil (Item 17, App. C)
Sealing compound (Item 20, App. C)
Sealing compound (Item 22.1, App. C)
Sealing compound (Item 24.1, App. C)

References
TM 9-2350-311-20-2
Manual traverse handwheel assembly maintenance p 9-40

a. Disassembly



NOTE

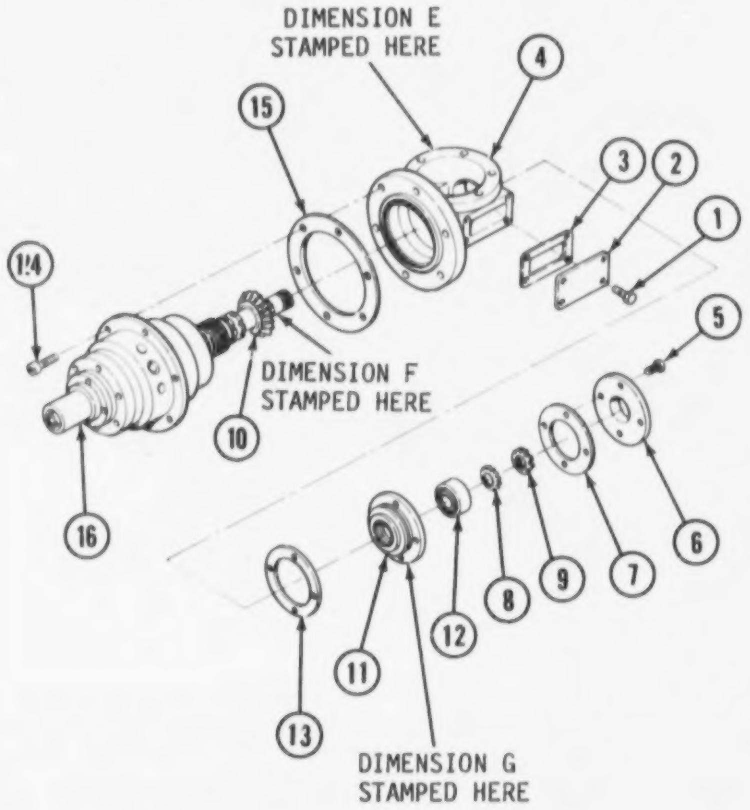
Relieve hydraulic system pressure before disassembly (ref. TM 9-2350-311-20-2).

1 Disconnect hydraulic line from housing of traversing mechanism. Place a suitable container under hydraulic line to catch any oil leakage.

2 Remove manual traverse handwheel assembly (ref. page 9-40).

3 Remove four bolts (1) and access cover (2).

4 Remove and discard gasket (3).


DIMENSION E
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DIMENSION F
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DIMENSION G
STAMPED HERE

5 Note and record dimension "E" on side of bevel gear housing (4).

NOTE

Have suitable container available to drain oil from bevel gear housing.

6 Remove four hex head cap screws (5) and access cover (6).

7 Remove and discard gasket (7).

8 Bend locking tab on keywasher (8) to disengage keywasher from nut (9).

9 Remove nut (9) and keywasher (8) from gearshaft assembly (10).

10 Remove retaining plate (11) and bearing (12) from gearshaft assembly (10). Discard bearing (12). Support end of gearshaft assembly (10).

11 Note and record dimension "G" stamped on retaining plate (11).

12 Remove shim (13) and save for reuse during assembly.

13 Remove six socket head cap screws (14) and bevel gear housing (4). Support gearshaft assembly (10).

14 Remove and discard gasket (15).

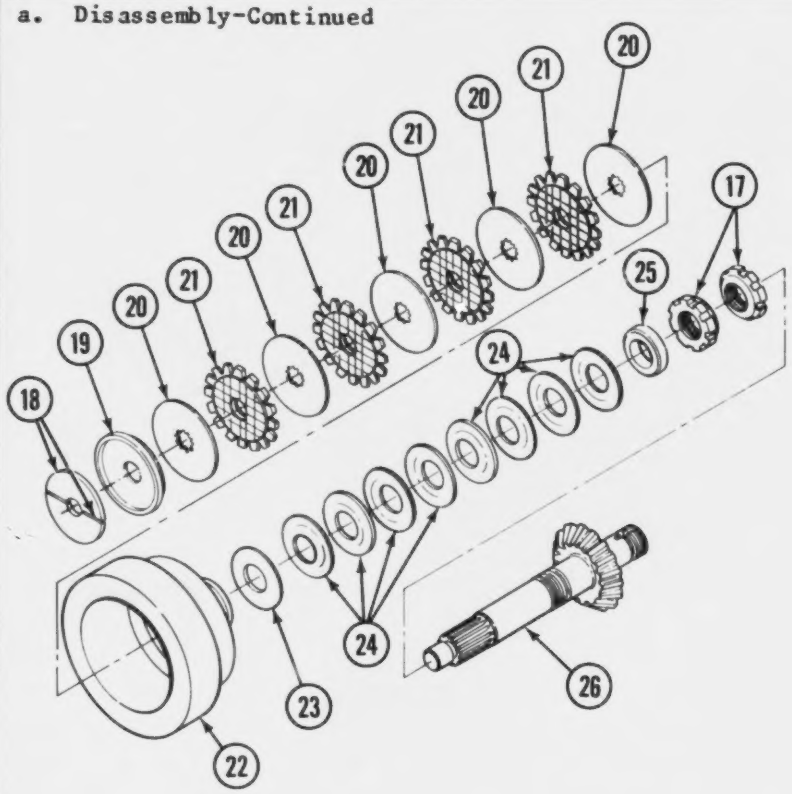
15 Note and record dimension "F" stamped on end of gearshaft assembly (10).

16 Remove gearshaft assembly (10) from housing (16).

TRAVERSING MECHANISM ASSEMBLY—Continued

9-6.1. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A4)—Continued

a. Disassembly-Continued



17 Back two nuts (17) off threads toward bevel gear end.

18 Remove two segments (18).

19 Remove retainer (19), five steel plates (20), and four friction plates (21).

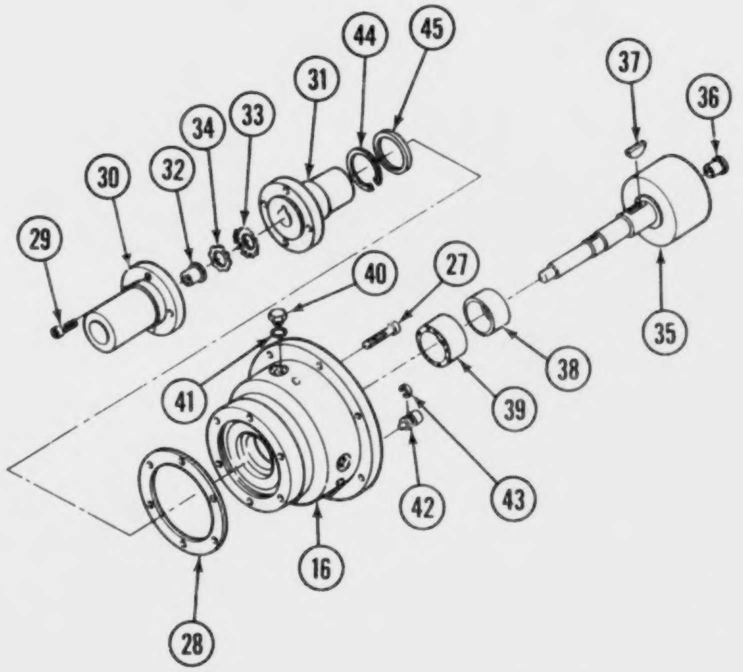
20 Remove clutch housing (22) and flat washer (23).

NOTE

Note position of spring washers for assembly.

21 Remove eight spring washers (24).

22 Remove spacer (25) and two nuts (17) from gearshaft (26).



23 Remove six screws (27) from inside housing, and remove housing (16) and gasket (28) from traversing mechanism. Discard gasket.

24 Remove four screws (29) and adapter (30) from adapter mount (31).

25 Place clutch and shaft assembly in vise; remove and discard bearing (32).

26 Straighten tabs on washer (33) and remove nut (34) and washer.

27 Pull clutch shaft (35) and bearing (36) from adapter mount (31) and housing (16) and remove key (37).

28 Separate inner race (38) and outer race (39) from adapter mount (31).

29 Remove adapter mount (31).

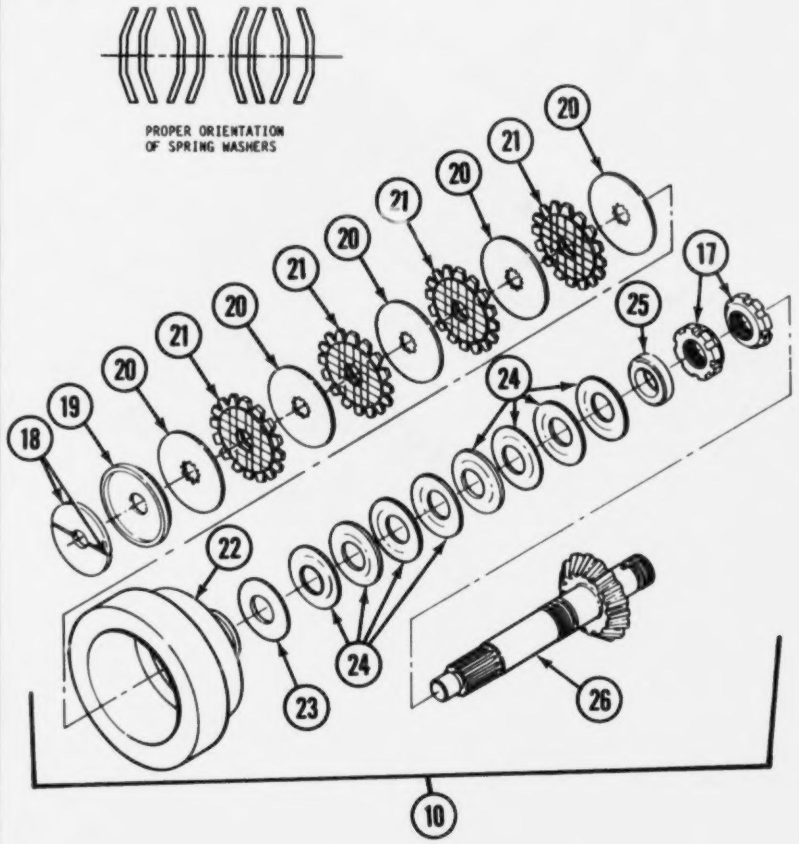
30 Remove two plugs (40) and two packings (41) and push three pistons (42) and three seals (43) out of housing (16). Discard seals.

31 Remove snap ring (44) to release seal (45). Remove and discard seal.

TRAVERSING MECHANISM ASSEMBLY—Continued

9-6.1. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A4)—Continued

b. Assembly



1 Install two nuts (17) loosely on gearshaft (26).

2 Install spacer (25).

3 Install eight spring washers (24) on gearshaft according to orientation in illustration.

4 Install flat washer (23) and clutch housing (22) on gearshaft.

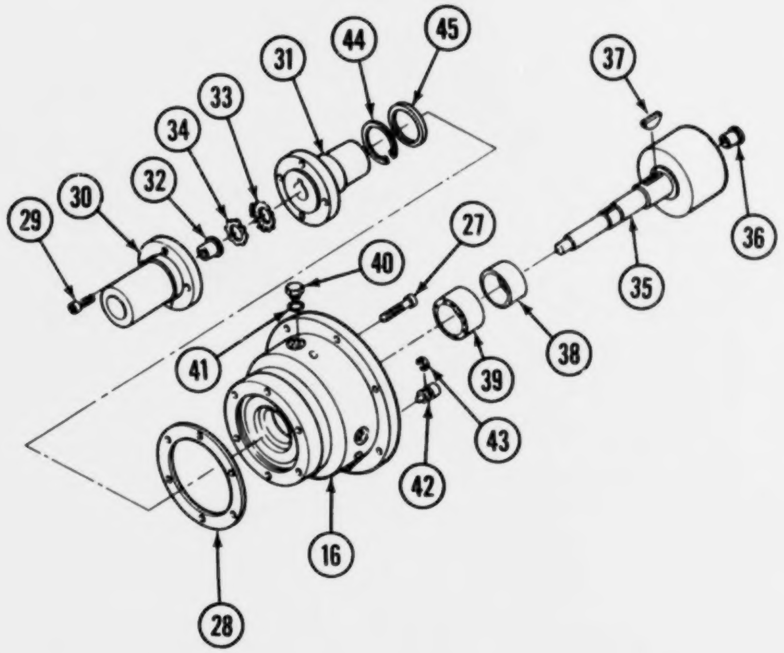
5 Soak friction plates (21) in lubricating oil (Item 17, App. C) before installing.

6 Install five steel plates (20) and four friction plates (21) on gearshaft in clutch housing (22). Alternate plates with friction plates between steel plates. Aline gear teeth of friction plates for installation in housing (16).

7 Install retainer (19) against steel plate.

8 Position two segments (18) in groove and hold; hand-tighten nuts (17) against spacer (25) until segments are secure.

9 Install bearing (36) on end of gearshaft assembly (10) and position in cup of clutch shaft (35).



10 Place gearshaft assembly (10) and clutch shaft (35) in a vise.

11 Using a torque wrench and key adapter on hex end of gearshaft assembly, set nut (17) to break away at 250 ± 25 inch-pounds (28.3 ± 2.8 N·m). Tighten jam nut (17).

12 Install two packings (41) and two plugs (40) in housing (16).

13 Install new seal (45) in housing (16) and secure with snap ring (44).

14 Install three seals (43) and three pistons (42) into housing (16).

15 Position adapter mount (31) in housing (16).

16 Install inner race (38) and outer race (39) on adapter mount (31).

17 Install key (37) in clutch shaft and install clutch shaft (35) in housing (16).

18 Install washer (33) and nut (34) on clutch shaft. Bend locking tabs of washer to secure nut.

19 Install new bearing (32), and adapter (30) on clutch shaft and secure to adapter mount (31) using four screws (29).

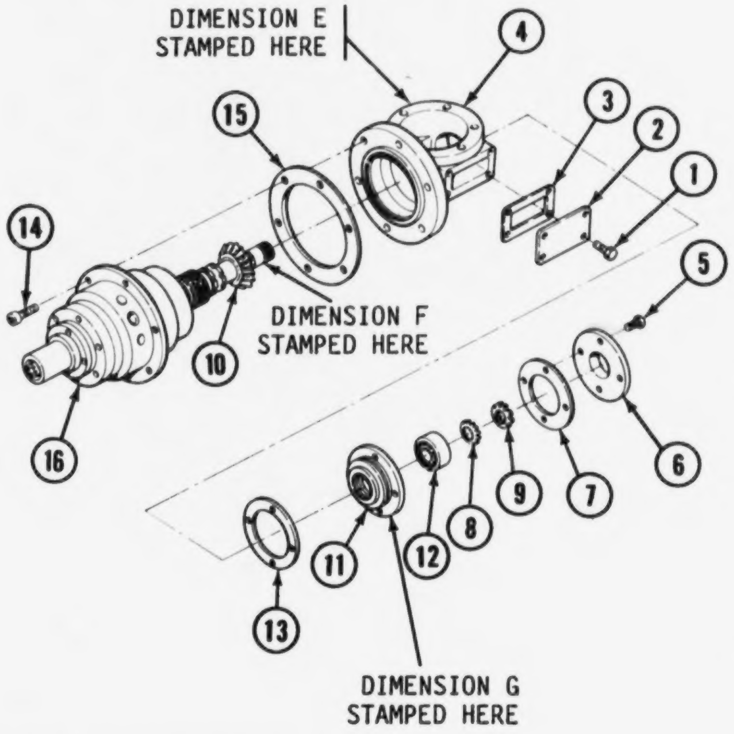
20 Apply sealing compound (Item 24.1, App. C) to new gasket (28) and install with housing (16) on traversing mechanism using six screws (27).

21 Position and support gearshaft assembly in bearing (36) and clutch shaft.

TRAVERSING MECHANISM ASSEMBLY—Continued

9-6.1. MANUAL TRAVERSE CLUTCH AND SHAFT ASSEMBLY (M109A4)—Continued

b. Assembly-Continued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SHIM THICKNESS IS F+G-E
0.001 TO 0.004 IN. BACKLASH AT ASSEMBLY

22 Apply sealing compound (Item 20, App. C) to six socket head cap screws (14).

23 Apply sealing compound (Item 24.1, App. C) to new gasket (15) and install with bevel gear housing (4) and six socket head cap screws (14) onto housing (16).

24 Install shim (13). Shim thickness must be equal to dimensions F+G-E to give 0.001- to 0.004-inch (0.025- to 0.10-mm) backlash at assembly. Use one shim and peel off laminations to obtain proper thickness.

25 Coat new bearing (12) with lubricating oil (Item 15, App C). Press bearing into retaining plate (11).

26 Install retaining plate (11) with bearing (12) onto gearshaft assembly (10).

27 Install keywasher (8) and nut (9) onto gearshaft assembly (10). Bend locking tab of keywasher (8) into slot in nut (9) to secure it.

28 Apply sealing compound (Item 24.1, App. C) to new gasket (7) and install with access cover (6) and four hex head cap screws (5).

29 Check backlash of bevel gears through hole in bevel gear housing (4). Adjust shim (13) thickness until backlash of 0.001 to 0.004 inch (0.025 to 0.10 mm) is obtained.

30 Install new gasket (3), access cover (2), and four bolts (1).

31 Fill bevel gear housing (4) with lubricating oil (Item 15, App. C) to bottom edge of access hole.

32 Install manual traverse handwheel assembly (ref. page 9-40).

33 Connect hydraulic line to housing of traversing mechanism.

34 Charge hydraulic system pressure (ref. TM 9-2350-311-20-2).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts
Hydraulic fluid (Item 11, App. C)
Sealing compound, grade C (Item 19, App. C)
Preformed packings
Lubricating oil (Item 17, App. C)
Shims
Seals
Lock wire
Gaskets

Special Tools
Sling assembly, lifting traverse mechanism, P/N 10942192 (Item 3, App. B)

Personnel Required
2

a. Removal

NOTE

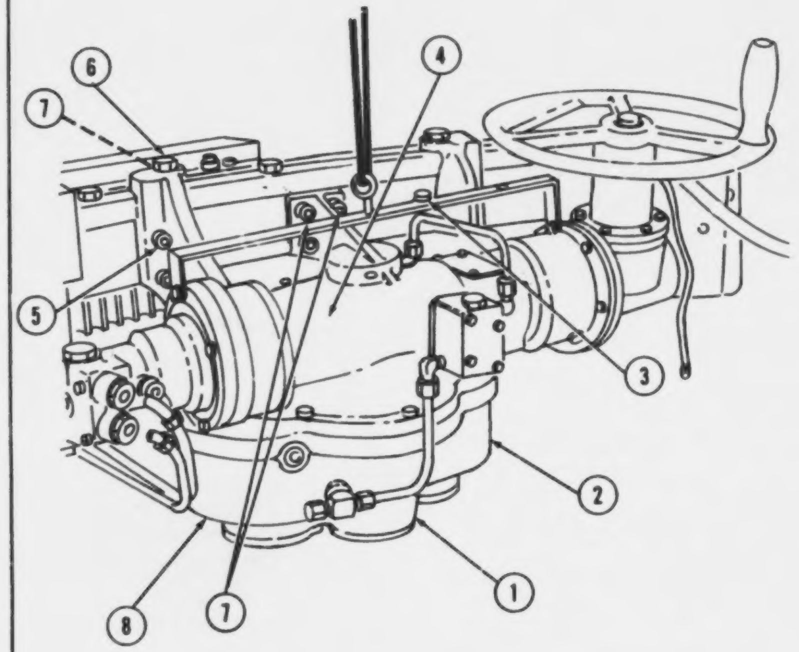
Place turret lock in locked position (ref. TM 9-2350-311-10) and turn off cab electrical power (ref. TM 9-2350-311-10) before servicing traversing mechanism.

1 Relieve hydraulic system pressure (ref. TM 9-2350-311-20-2).

NOTE

Step 2 applies to M109A2/M109A3 howitzers only.

2 Remove manual traverse clutch brush assembly (ref. page 9-2).



3 Remove lubricating pump and lines (ref. page 9-6).

4 Remove hydraulic motor and relief valve assembly as a unit (ref. page 9-17).

5 Remove manual traverse handwheel assembly (ref. page 9-41).

6 Remove manual traverse clutch and shaft assembly (ref. page 9-46 or page 9-48.2).

7 Remove drain plug (1) at bottom center of lower housing assembly (2). Drain 7 pints of lubricating oil in a suitable container. Replace drain plug (1).

8 Remove screw (3) from traversing mechanism lifting sling. Separate halves of the traversing mechanism lifting sling (Item 3, App. B) and clamp under traversing mechanism mounting brackets on upper housing assembly (4). Replace screw (3).

9 Lower lifting cable thru gunner's escape hatch. Attach to eye of traversing mechanism lifting sling (Item 3, App. B). Take up slack.

10 Remove eight vertical mounting screws (5) and two horizontal mounting screws (6).

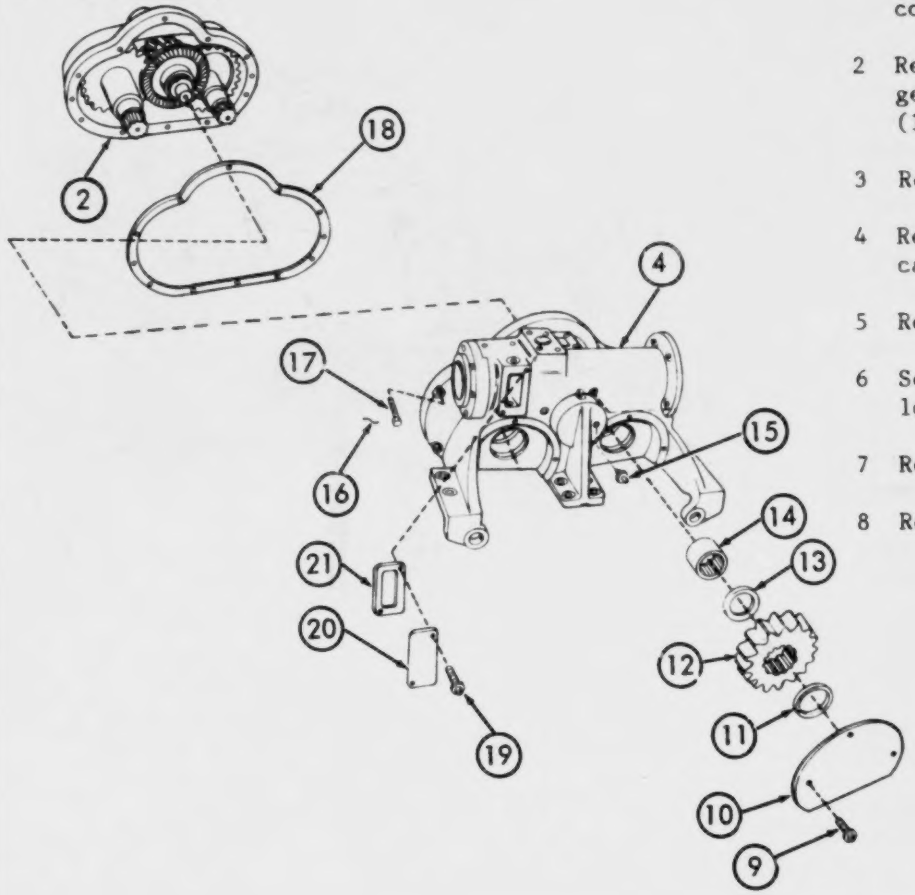
11 Remove shim(s) (7), if used, from between upper mounting flanges and top of cab inner race ring. Tag shim(s) (7) and retain for use during installation.

12 Lift traversing mechanism (8) and remove through gunner's escape hatch.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM – Continued

b. Disassembly



1 Remove six bolts (9) and two spur gear covers (10).

2 Remove two retainer rings (11), two spur gears (12), two seals (13) and two bearings (14). Discard two seals (13).

3 Remove two lubrication fittings (15).

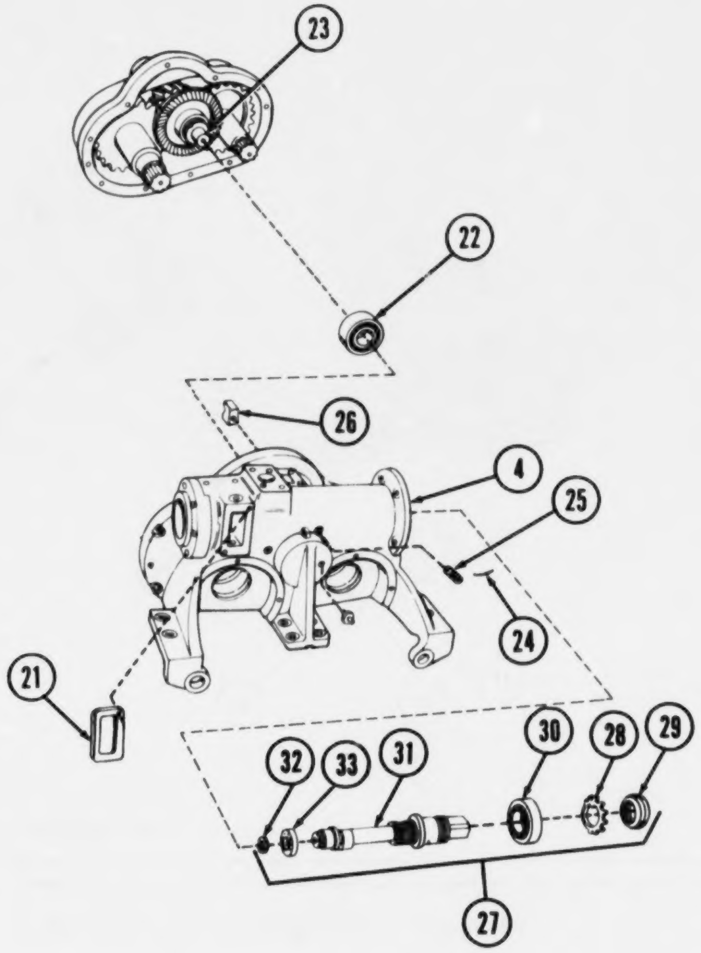
4 Remove and discard lock wire (16) from ten cap screws (17).

5 Remove ten cap screws (17).

6 Separate upper housing assembly (4) from lower housing assembly (2).

7 Remove and discard gasket (18).

8 Remove two bolts (19) and cover (20).



9 Remove and discard gasket (21).

10 Remove bearing (22) from lower housing gear shaft (23).

11 Remove and discard lock wire (24) from setscrew (25).

12 Remove setscrew (25) and pressure block (26) from upper housing assembly (4).

13 Remove gear shaft group (27) from upper housing assembly (4).

14 Straighten locking tabs on keywasher (28).

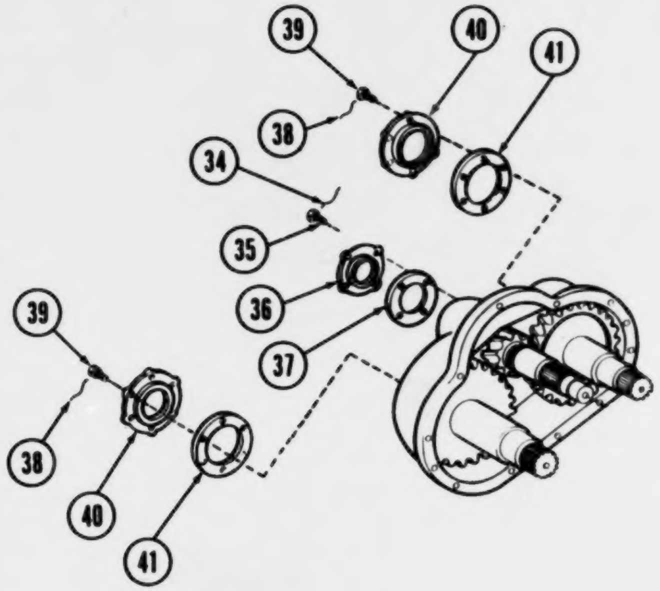
15 Remove nut (29), keywasher (28) and bearing (30) from gear shaft (31).

16 Remove retaining ring (32) and bearing (33) from gear shaft (31).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM – Continued

b. Disassembly-Continued



17 Remove and discard lock wire (34) from four screws (35).

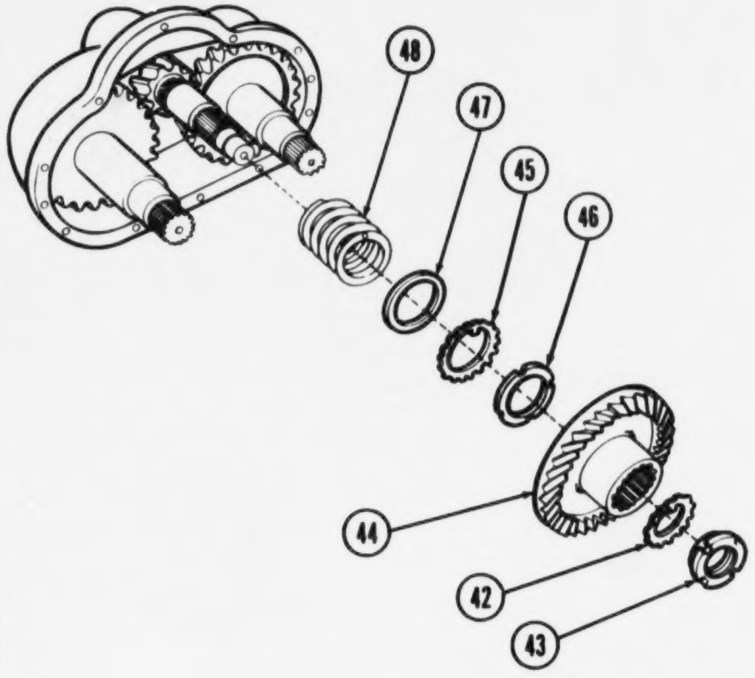
18 Remove four screws (35) and (center) drive shaft cover (36).

19 Remove and discard gasket (37).

20 Remove two lock wires (38) from 12 screws (39) on left and right shaft covers (40) and discard.

21 Remove 12 screws (39) and left and right shaft covers (40).

22 Remove and discard two gaskets (41).



23 Disengage tabs of keywasher (42) from round, slotted locknut (43).

24 Remove round, slotted locknut (43) and keywasher (42).

25 Remove bevel gear (44).

26 Disengage tabs of keywasher (45) from round, slotted locknut (46).

WARNING

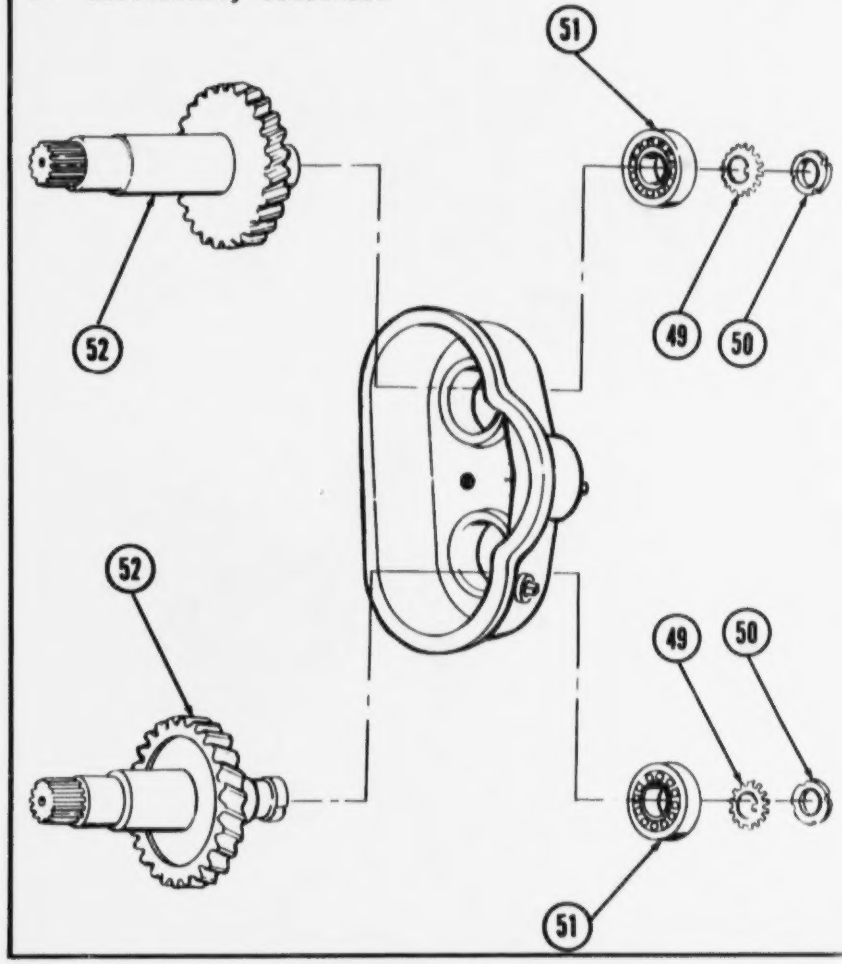
Anti-backlash spring is held under compression by locknut. To avoid injury, restrain spring while removing nut.

27 Remove round, slotted locknut (46), keywasher (45), flat washer (47) and anti-backlash spring (48).

TRAVERSING MECHANISM ASSEMBLY — Continued

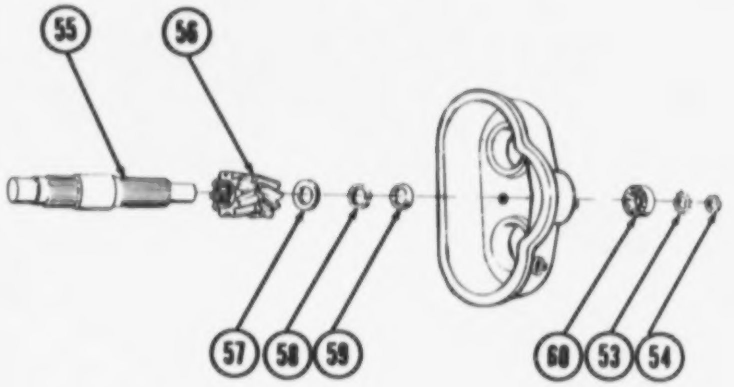
9-7. TRAVERSING MECHANISM – Continued

b. Disassembly-Continued



28 Disengage tabs of two keywashers (49) from two locknuts (50).

29 Remove two locknuts (50), two keywashers (49), two ball bearings (51) and two helical gear shafts (52).



30 Disengage tab of keywasher (53) from locknut (54).

31 Remove locknut (54) and keywasher (53).

32 Withdraw shouldered shaft (55).

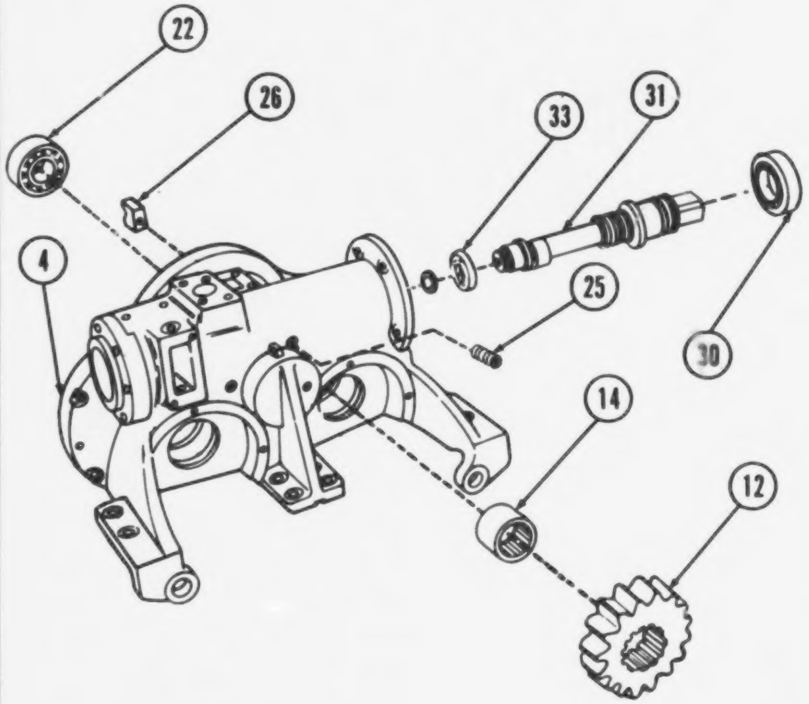
33 Remove helical cluster gear (56), shouldered washer (57), spacer (58) and shim(s) (59). Retain shim(s) (59) for use during assembly.

34 Remove ball bearing (60).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM — Continued

c. Inspection and Repair



1 Inspect two spur gears (12). Replace if teeth are cracked or broken.

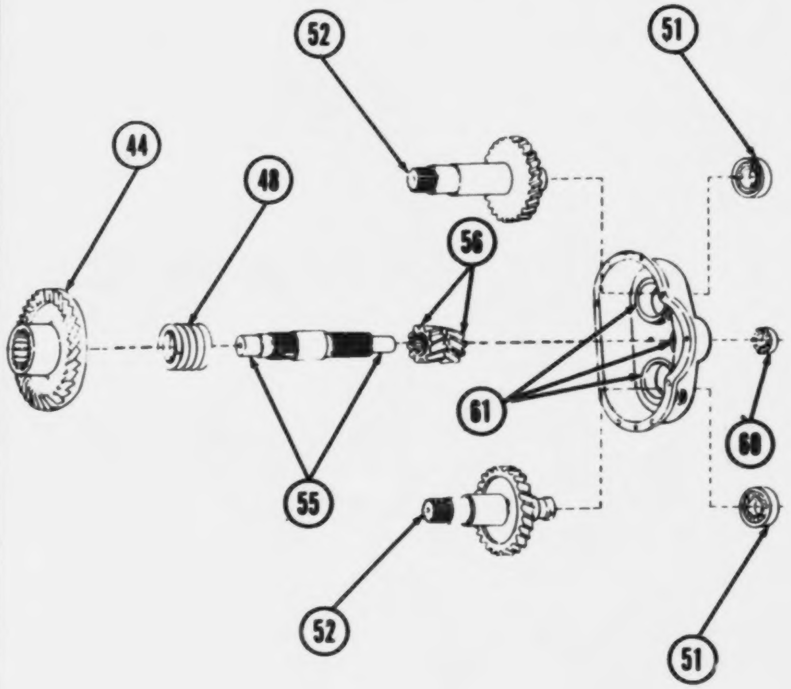
2 Inspect bearings (14, 22, 30 and 33) ref. TM 9-214).

3 Inspect gear shaft (31). If teeth are cracked or broken, replace gear shaft (31) and bevel gear (44) as a matched set.

4 Inspect upper housing assembly (4). If upper housing assembly (4) is cracked, replace entire traversing mechanism.

5 Inspect setscrew (25). Replace if damaged.

6 Inspect pressure block (26). Replace if damaged or worn to less than 7/16 inch (1.1 cm).



7 Inspect two ball bearings (51) and ball bearing (60) (ref. TM 9-214).

8 Inspect lower housing (61). If lower housing (61) is cracked, replace entire traversing mechanism.

9 Inspect gear teeth of two helical gear shafts (52). Replace if teeth are cracked or broken.

10 Check backlash of two helical gear shafts (52) with helical cluster gear (56). Replace if backlash is greater than 0.010 inch (0.25 mm).

11 Inspect helical cluster gear (56). Replace if teeth are cracked or broken.

12 Inspect threads and splines of shouldered shaft (55). Repair damaged threads. Replace shouldered shaft (55) if splines are cracked or broken.

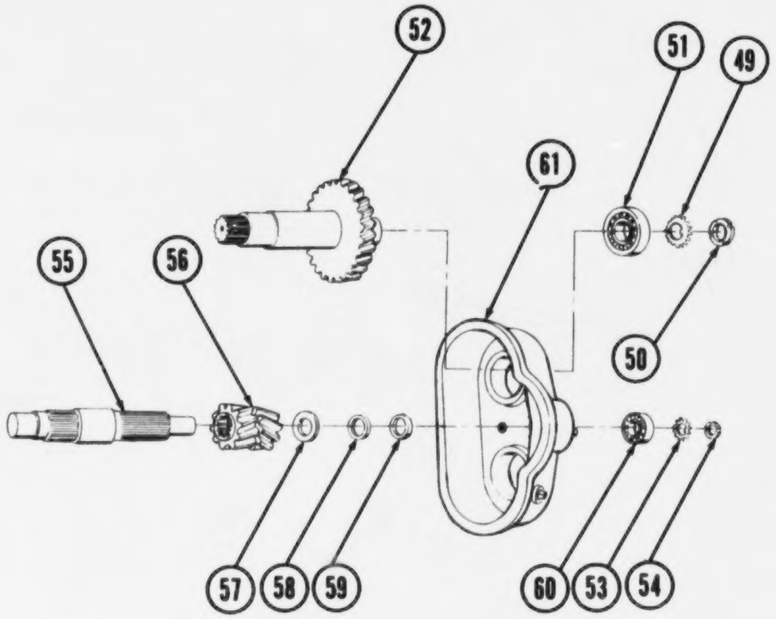
13 Inspect anti-backlash spring (48). Replace if cracked, scratched, nicked or distorted.

14 Inspect bevel gear (44). If teeth are broken or damaged, replace bevel gear (44) with shouldered shaft (55) as a matched set.

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM — Continued

d. Assembly



1 Install ball bearing (60).

2 Install helical cluster gear (56), shouldered washer (57), spacer (58) and shim(s) (59) on shouldered shaft (55). Use original shim(s) (59) from disassembly whenever possible. Thickness of shim(s) = A + 0.003 (0.08 mm) - MD+X; where A is stamped on housing (61), MD is stamped or etched on bevel gear (44), and X is measured at assembly from top of lower housing gasket to top of shaft shoulder (55) below bevel gear (44).

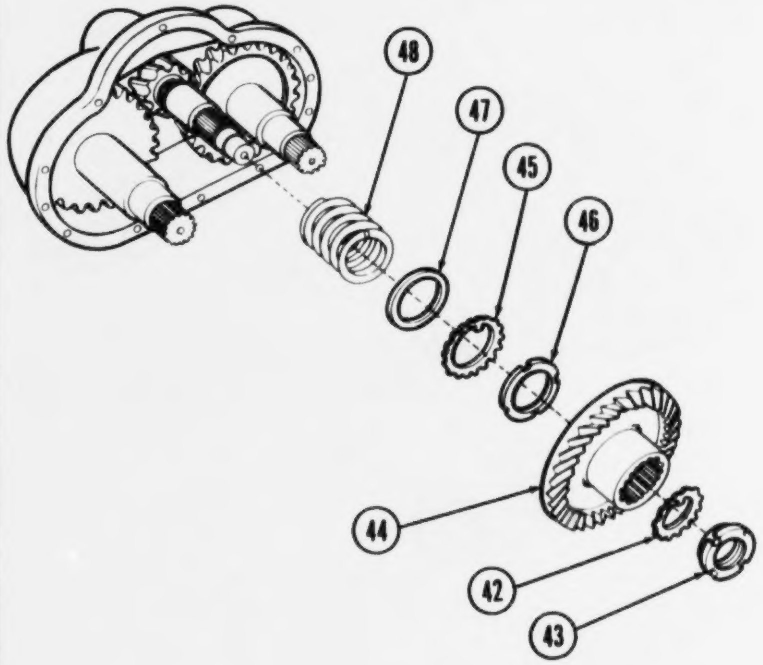
3 Install shouldered shaft (55) with assembled parts.

4 Install keywasher (53) and locknut (54).

5 Bend tab of keywasher (53) to secure locknut (54).

6 Install two helical gear shafts (52), two ball bearings (51), two keywashers (49) and two locknuts (50).

7 Bend tabs of two keywashers (49) to secure locknuts (50).



WARNING

Anti-backlash spring is held under compression by locknut. To avoid injury, restrain spring while installing locknut.

8 Install anti-backlash spring (48), flat washer (47), keywasher (45) and round, slotted lock nut (46).

9 Bend tabs of keywasher (45) to secure round, slotted locknut (46).

10 Install bevel gear (44). If new bevel gear (44) is used, it must be installed with gear shaft (31) (ref. page 9-63) as matched set.

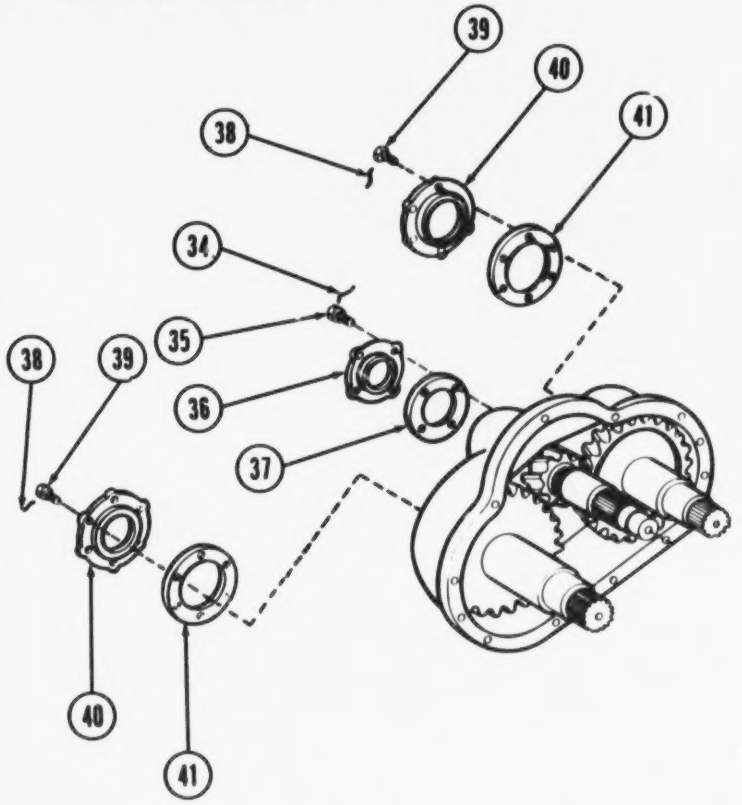
11 Install keywasher (42) and round, slotted locknut (43).

12 Bend tab of keywasher (42) to secure round, slotted locknut (43).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM — Continued

d. Assembly-Continued

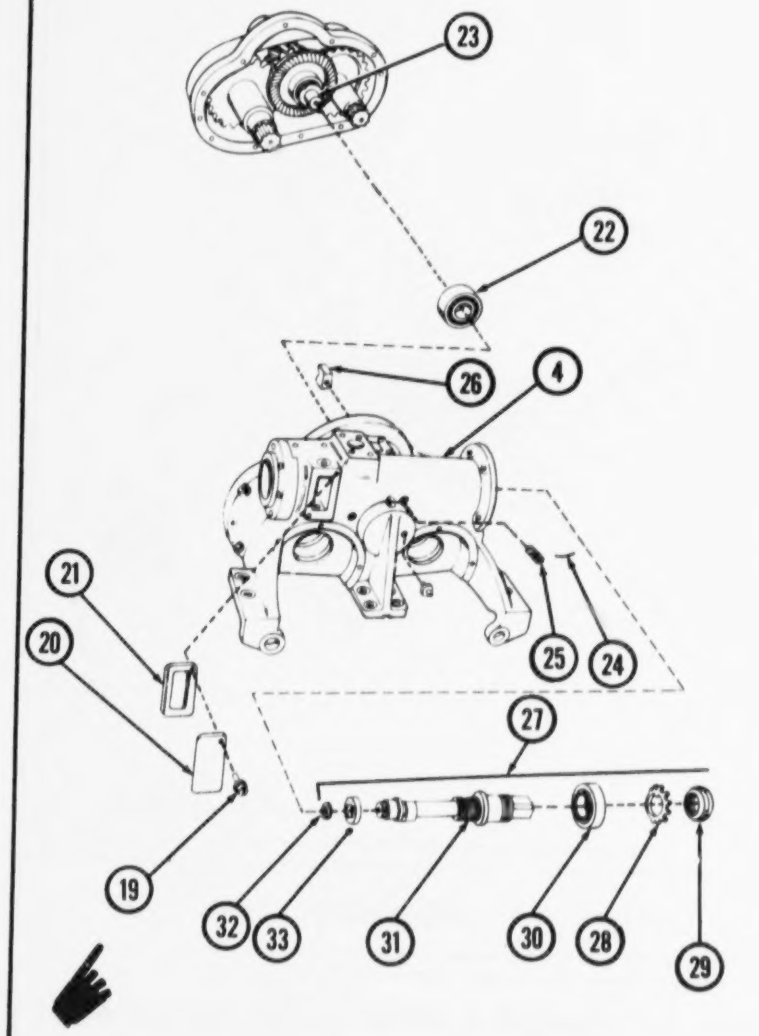


13 Install two new gaskets (41), left and right shaft covers (40) and 12 screws (39).

14 Install two new lock wires (38) to secure 12 screws (39) on left and right shaft covers (40).

15 Install new gasket (37), (center) drive shaft cover (36) and four screws (35).

16 Install new lock wire (34) to secure four screws (35) on (center) drive shaft cover (36).



17 Install bearing (33) and retaining ring (32) on gear shaft (31).

18 Install bearing (30), keywasher (28), and nut (29) on gear shaft (31). (Gear shaft (31) must be installed with bevel bear (44) as a matched set.)

19 Bend tab of keywasher (28) to secure nut (29).

20 Install gear shaft group (27) in upper housing assembly (4).

21 Install pressure block (26) and setscrew (25) in upper housing assembly (4). Adjust setscrew (25) so that pressure block (26) allows drive bevel pinion gear shaft to move with slight drag.

22 Secure setscrew (25) with new lock wire (24).

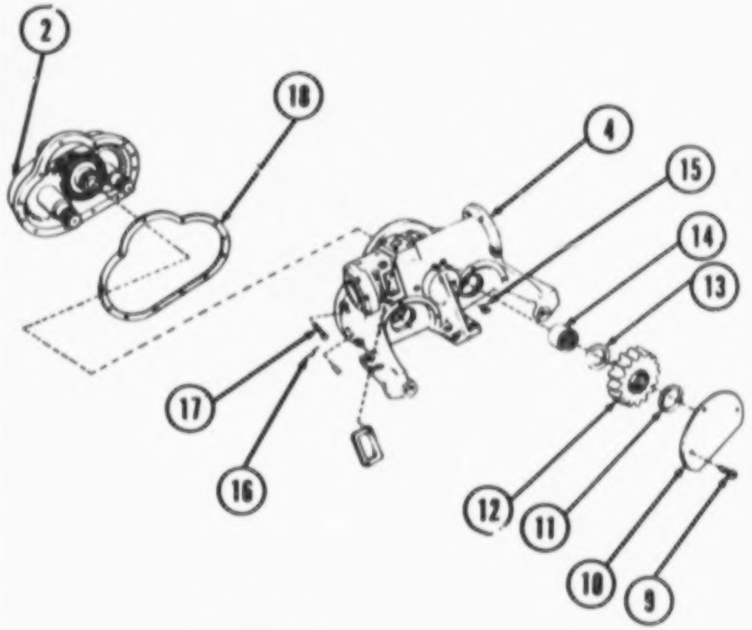
23 Install bearing (22) on lower housing gear shaft (23).

24 Install new gasket (21), cover (20) and two bolts (19).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM — Continued

d. Assembly-Continued



25 Install new gasket (18) on lower housing assembly (2). If gasket (18) does not match shape of housing well, it may be restored to proper contour by dipping in hot water for one to two minutes. Pat gasket (18) dry and install on lower housing assembly (2). Repeat as necessary.

26 Install upper housing assembly (4) and ten cap screws (17) to lower housing assembly (2). Check backlash between bevel gear (ref. page 9-61) and gear shaft (ref. page 9-63). If backlash exists, shim as required (ref. page 9-60).

27 Install new lock wire (16) to secure ten cap screws (17).

28 Install two lubrication fittings (15).

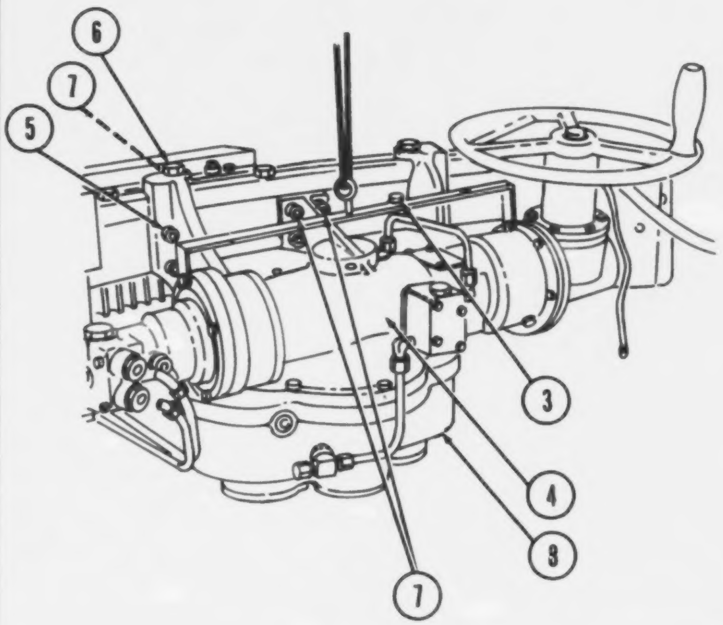
29 Install two bearings (14), two new seals (13), two spur gears (12), and two retainer rings (11).

30 Install two spur gear covers (10) and six bolts (9).

TRAVERSING MECHANISM ASSEMBLY — Continued

9-7. TRAVERSING MECHANISM — Continued

e. Installation



1 Remove screw (3) from traversing mechanism lifting sling. Separate halves of traversing mechanism lifting sling and clamp under traversing mechanism mounting brackets on upper housing assembly (4). Replace screw (3).

2 Attach lifting cable to eye of traversing mechanism lifting sling (Item 3, App. B). Take up slack.

3 Lower traversing mechanism (8) thru gunner's escape hatch.

4 Install any shim(s) (7), if used.

5 Install two horizontal mounting screws (6) and eight vertical mounting screws (5).

6 Remove traversing mechanism lifting sling.

7 Install manual traverse clutch and shaft assembly (ref. page 9-46 or page 9-48.2).

8 Install manual traverse handwheel assembly (ref. page 9-40).

9 Install hydraulic motor and relief valve assembly as a unit (ref. page 9-26).

10 Install lubricating pump and lines (ref. page 9-14).

NOTE

Step 11 applies to M109A2/M109A3 howitzers only.

11 Install manual traverse clutch brush assembly (ref. page 9-2).

12 Fill traversing mechanism with lubricating oil (ref. LO 9-2350-311-12).

CHAPTER 10 COMMANDER'S CUPOLA

GENERAL

This chapter illustrates and describes the removal, disassembly, assembly, installation, inspection, repair and adjustment procedures for the howitzer commander's cupola assembly. These maintenance procedures are functions authorized for direct and general support level maintenance.

Title	Page
10-1. CUPOLA COVER, BODY AND HANDLE	10-2
10-2. CUPOLA RACE RING	10-11

COMMANDER'S CUPOLA — Continued

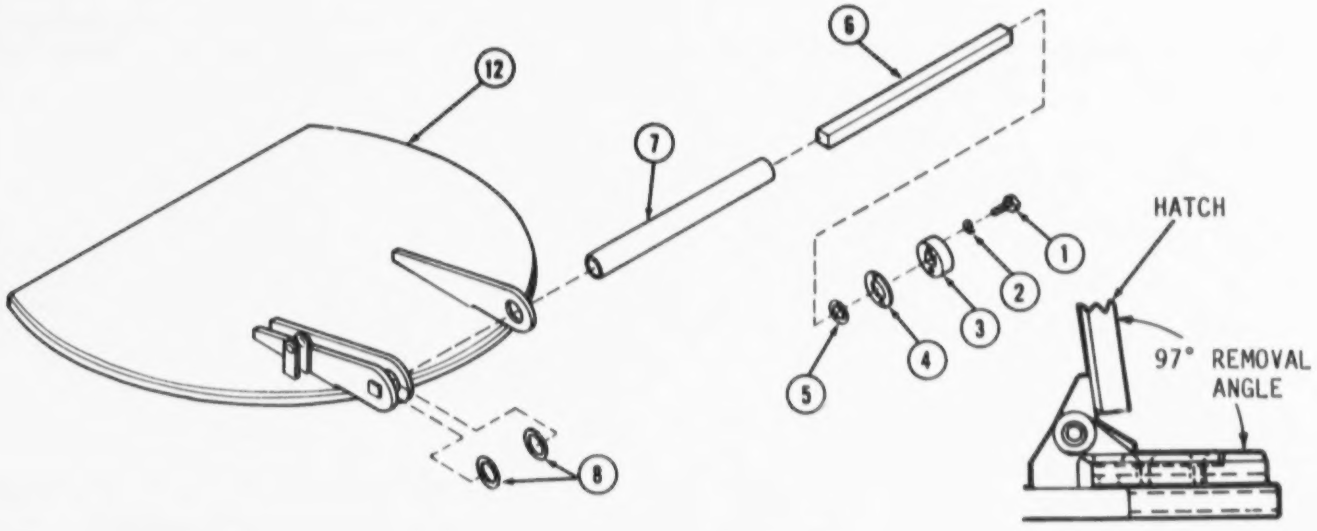
10-1. CUPOLA COVER, BODY AND HANDLE

This task covers: a. Removal b. Disassembly c. Assembly
d. Installation e. Adjustment

INITIAL SET-UP

Materials/Parts
Cotter pins
Lock washers
Gasket
Bowed washer
Shims
Adhesive (Item 3, App. C)
Grease (Item 8, App. C)
Solid film lubricant (Item 12, App. C)

a. Removal



1 To remove cupola cover, unlatch cupola cover (12) and open to upright position. Support cupola cover (12) in upright position to release preload on torsion bar (6).

2 Remove two screws (1) and two flat washers (2).

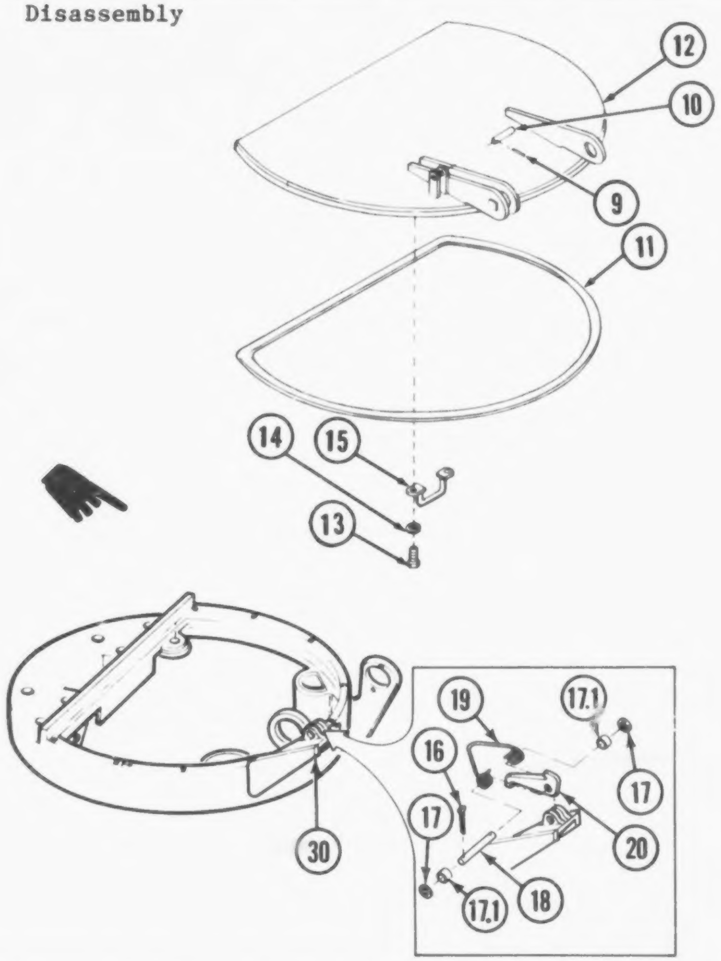
3 Remove anchor plate (3), anchor shims (4) and tube shims (5).

4 Remove torsion bar (6), torsion bar tube (7) and two tube shims (8).

COMMANDER'S CUPOLA — Continued

10-1. CUPOLA COVER, BODY AND HANDLE – Continued

b. Disassembly



1 To disassemble cupola cover (12), remove lock pin (9) and pin (10).

2 Strip off cover seal (11). Discard cover seal (11).

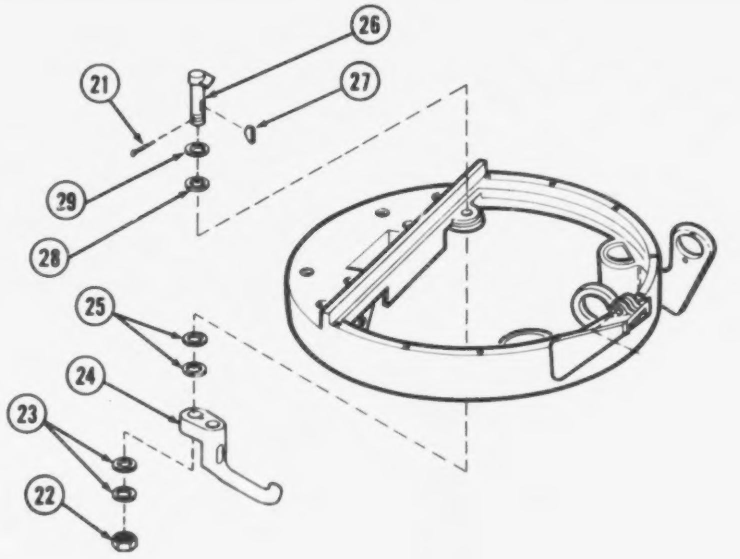
NOTE

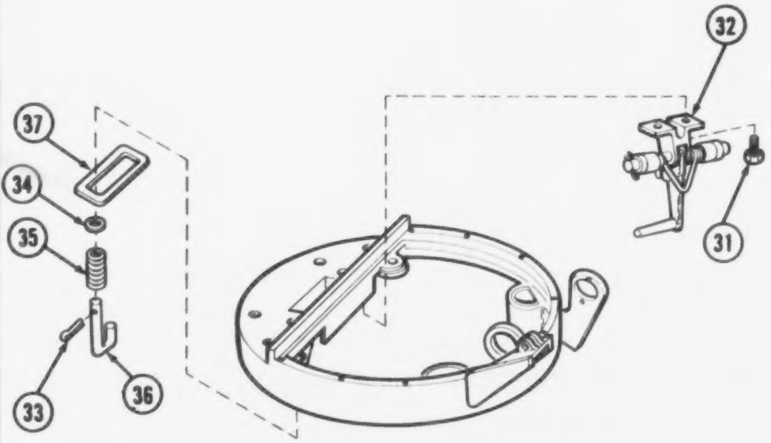
Scrape dirt and adhesive from cover seal seat.

3 Lift off cupola cover (12).

4 Remove two screws (13), two lock washers (14) and locking cam seat (15). Discard two lock washers (14).

5 To disassemble cupola body, remove two cotter pins (16), two flat washers (17), two spacers (17.1), latch pin (18), latch spring (19) and latch (20) from latch bracket (30). Discard two cotter pins (16).





6 Remove cotter pin (21), castle nut (22), two shims (23), latch handle (24) and two shims (25). Discard cotter pin (21), two shims (23) and two shims (25).

7 Remove locking cam (26), cam key (27), shim (28) and bowed washer (29). Discard bowed washer (29) and shim (28).

8 Remove two bolts (31) and locking latch (32).

9 Remove two cotter pins (33), two flat washers (34), two springs (35) and two periscope hooks (36). Discard two cotter pins (33).

10 Strip off gasket (37). Discard gasket (37).

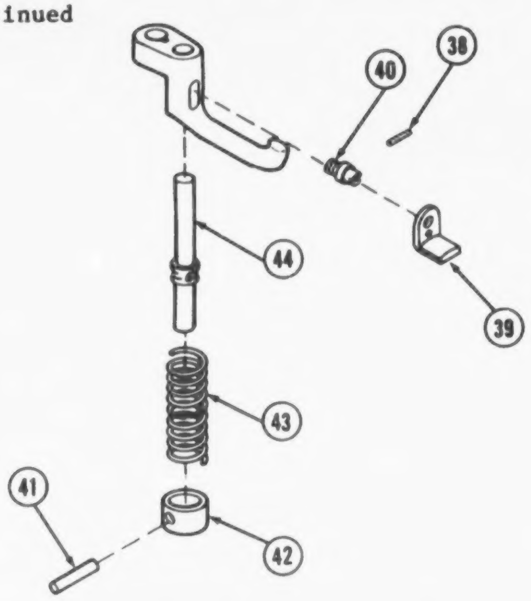
NOTE

Clean dirt and adhesives from gasket seat.

COMMANDER'S CUPOLA — Continued

10-1. CUPOLA COVER, BODY AND HANDLE — Continued

b. Disassembly-Continued



11 To disassemble cupola handle assembly, remove pin (38) and remove release lever (39).

12 Remove screw (40).

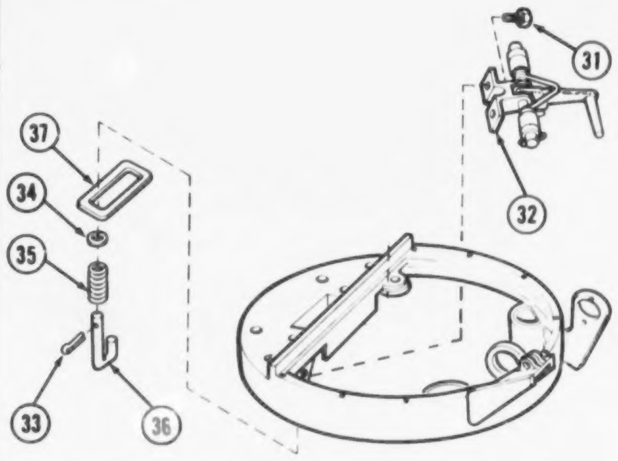
13 Remove pin (41), retainer (42), spring (43) and guide (44).

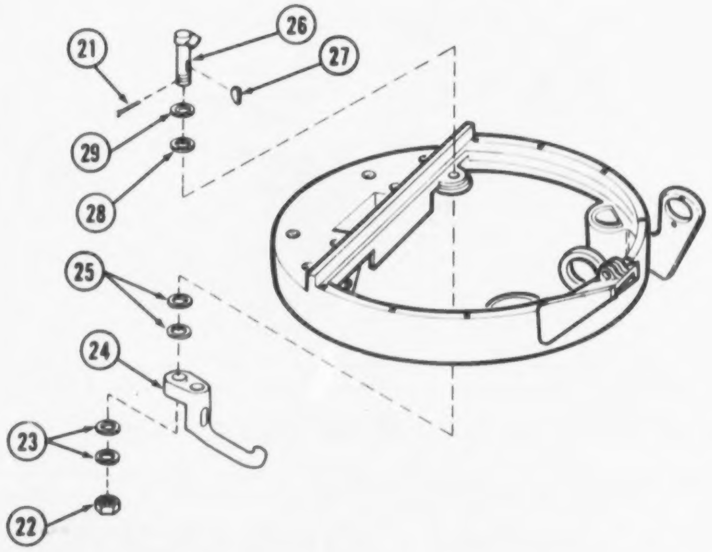
c. Assembly

1 To assemble cupola handle assembly, install guide (44), spring (43), retainer (42) and pin (41).

2 Install screw (40).

3 Install release lever (39) and install pin (38).





4 To assemble commander's cupola body, install new gasket (37) with adhesive (Item 3, App. C) onto clean gasket (37) seat.

5 Install two periscope hooks (36), two springs (35) and two flat washers (34). Install two new cotter pins (33).

6 Install locking latch (32) and two bolts (31).

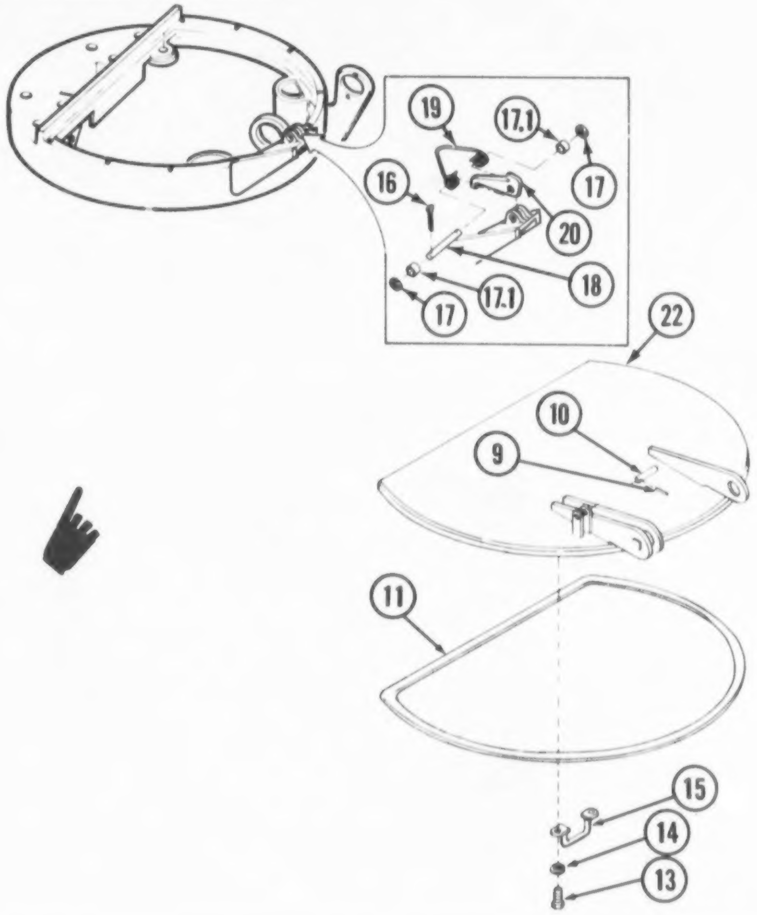
7 Install new bowed washer (29), shim (28), cam key (27) and locking cam (26).

8 Install two shims (25), latch handle (24), two new shims (23) and castle nut (22). Install new cotter pin (21).

COMMANDER'S CUPOLA — Continued

10-1. CUPOLA COVER, BODY AND HANDLE – Continued

c. Assembly-Continued



9 Install latch (20), latch spring (19), latch pin (18), two spacers (17.1) and two flat washers (17). Install two new cotter pins (16).

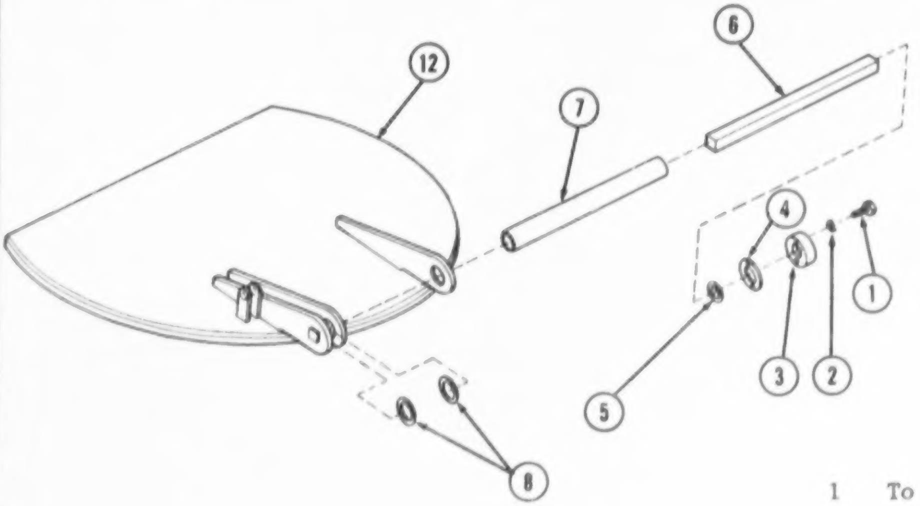
10 To install cupola cover (12), install locking cam seat (15), two new lock washers (14) and two screws (13).

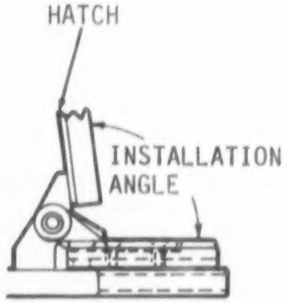
11 Install new cover seal (11) with adhesive (Item 3, App. C) on cleaned cover seal (11) seat.

12 Place cupola cover (12) on top of (11) cover seal (11).

13 Install pin (10) and lock pin (9).

d. Installation





1 To install cupola cover (12), support cupola cover (12) in upright position. Install two tube shims (8), torsion bar tube (7) and torsion bar (6).

2 Coat torsion bar (6) with grease (Item 8, App. C). Install torsion bar (6) with cupola cover (12) at a 97° angle from closed position. Install tube shims (5), anchor shims (4) and anchor plate (3).

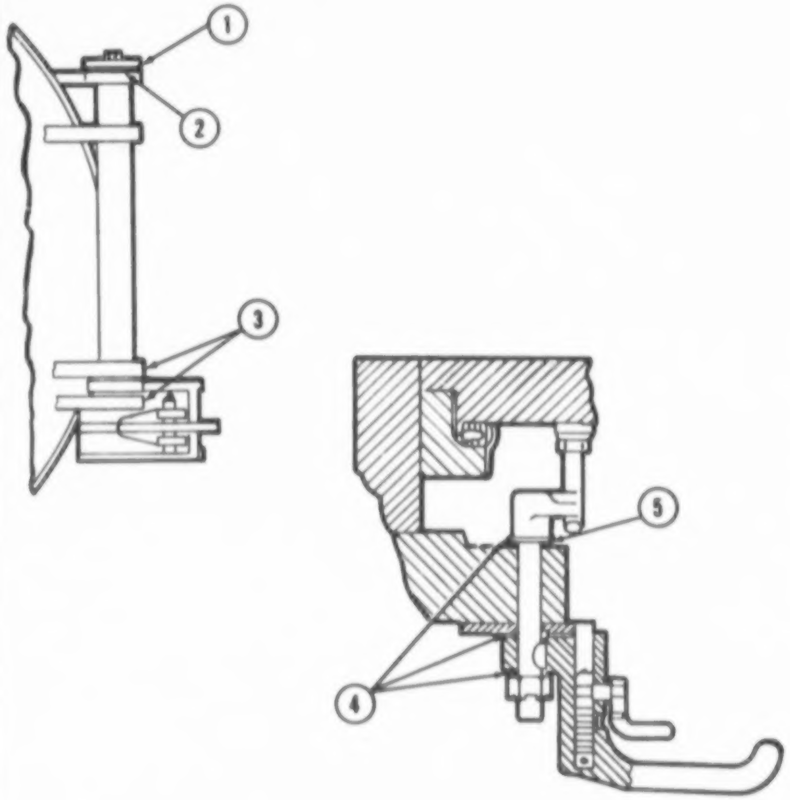
3 Install two flat washers (2) and two screws (1).

4 Close cupola cover (12) and engage latch to keep cupola cover (12) in position.

COMMANDER'S CUPOLA — Continued

10-1. CUPOLA COVER, BODY AND HANDLE — Continued

e. Adjustment



1 To adjust anchor/torsion bar assembly on cupola cover (12), insert shim(s) (1) as required. Provide a 0.016 ± 0.063 inch (0.406 ± 1.6 mm) clearance between spring ends and anchor plate.

2 Insert shim(s) (2) as required. Provide a .005 ± 0.20 inch (.127 ± 5.08 mm) clearance between tube end and cover hinge.

3 Insert shim(s) (3) as required. Center hatch in cupola body within 0.045 inch (1.1 mm).

4 Insert shim(s) (4) as required. Provide washer (5) depression of approximately 0.031 inch (.787 mm) in UNLOCK position.

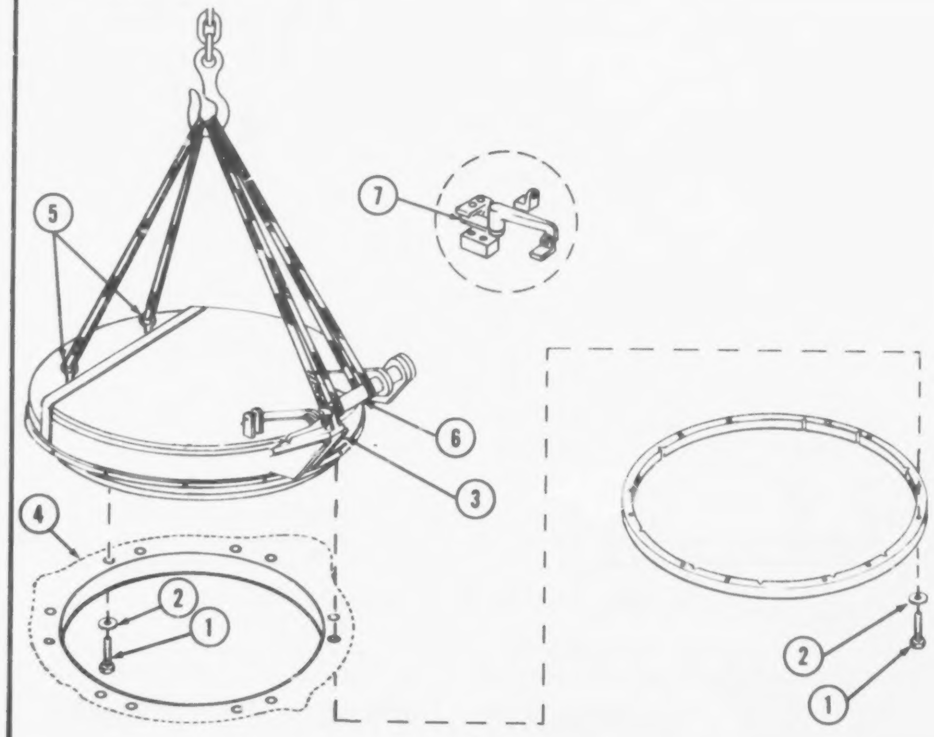
10-2. CUPOLA RACE RING

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts	Test Equipment	Personnel Required
Adhesive (Item 3, App. C)	Micrometer	2
Lock washers		

a. Removal



WARNING

Cupola weighs 360 pounds (163.4 kilograms). Use hoist and sling capable of lifting 1000 pounds (454 kilograms) to provide adequate lifting capacity and prevent injury.

NOTE

Cupola on later design vehicles does not have outside latch hand (7) pictured here.

COMMANDER'S CUPOLA — Continued

10-2 CUPOLA RACE RING – Continued

a. Removal-Continued

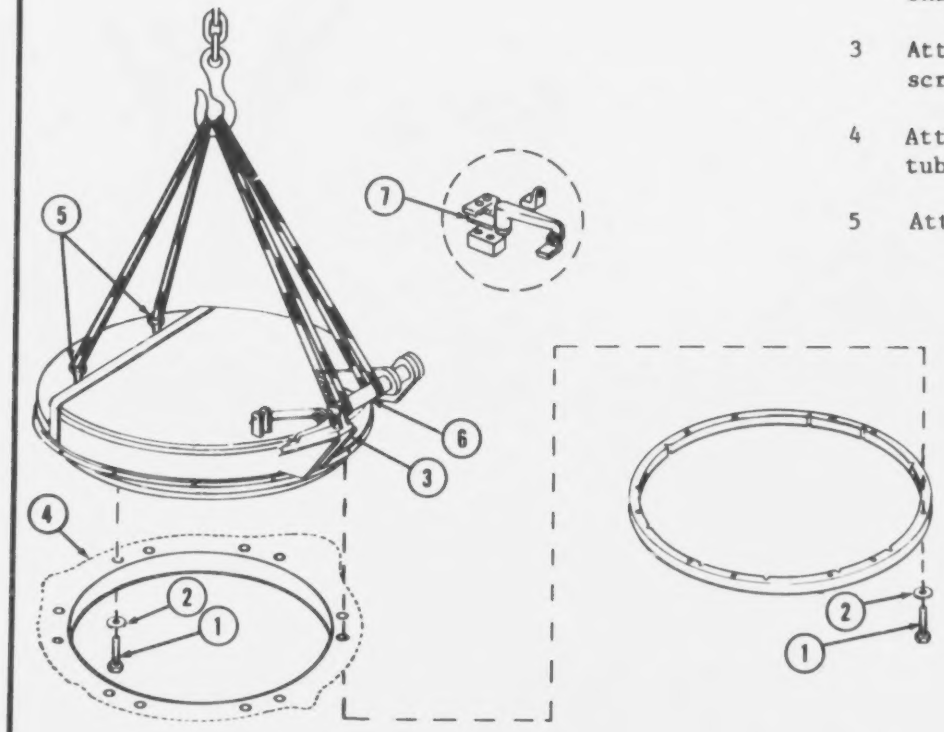
1 Remove machinegun support prior to cupola assembly removal, (ref. TM 9-2350-311-20-2).

2 Remove 12 screws (1) and 12 flat washers (2) that attach cupola (3) to cab (4).

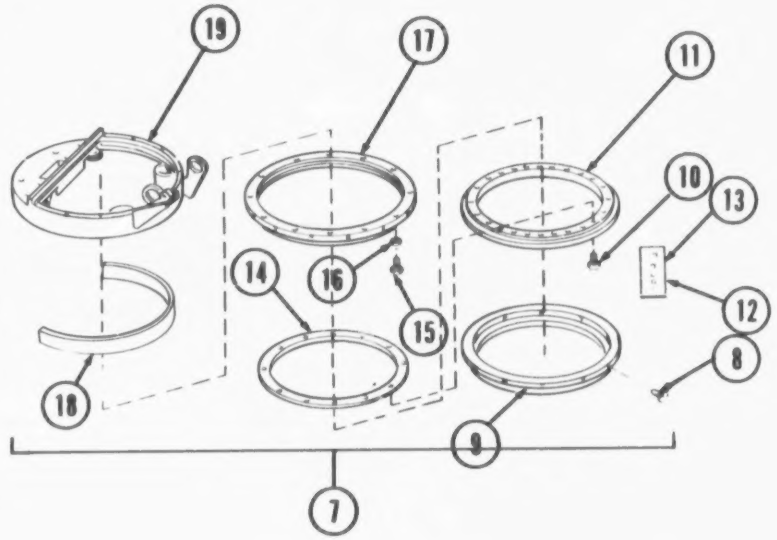
3 Attach two eyebolts (5) to cupola (3) on screw holes for machinegun support.

4 Attach sling to two eyebolts (5) and hinge tube cover (6).

5 Attach hoist to sling. Remove cupola (3).



b. Disassembly



1 Invert commander's cupole body and ring assembly (7).

NOTE

Note slot on inside of each ring. slots are in line.

2 Remove 12 screws (8) and race ring shield (9).

3 Remove 12 screws (10) and lower race ring (11).

4 Remove 128 white, cream or yellow balls (12) and 128 pink or red balls (13) and upper (inner) ring (14).

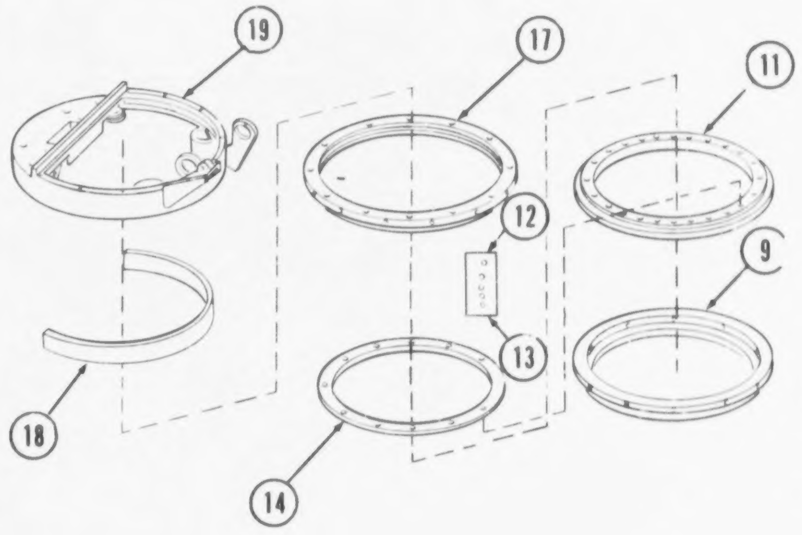
5 Remove 12 screws (15), 12 lock washers (16) and outer race ring (17). Discard lock washers (16).

6 Separate cushioning pad (18) from cupola body assembly (19), pulling cushioning pad (18) away.

COMMANDER'S CUPOLA — Continued

10-2. CUPOLA RACE RING — Continued

c. Inspection and Repair



1 Clean all parts of race ring assembly in accordance with standard maintenance procedures prescribed on page 2-18 and 2-19.

CAUTION

White, cream or yellow balls must be replaced as a set. If any are found defective, order a new set.

2 Inspect 128 white, cream or yellow balls (12). Measure diameters. Replace if scored or damaged, or if outside diameter is less than 0.4058 inch (10.31 mm) per ball.

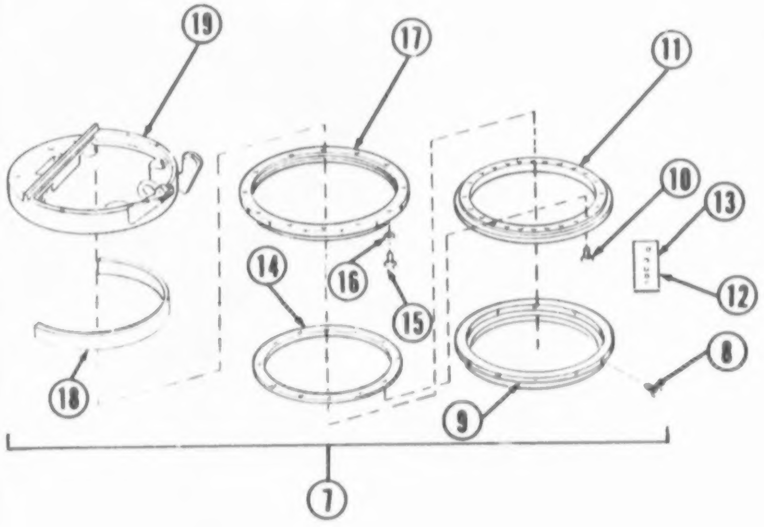
3 Inspect 128 pink or red balls (13). Replace if scored or damaged.

4 Inspect race rings (9), (11), (14) and (17). Replace if cracked or distorted.

5 Inspect threads on race rings (9), (11), (14) and (17) and cupola body assembly. Retap if damaged.

6 Replace cushioning pad (18) if torn or missing.

d. Assembly



1 Invert commander's cupola body and ring assembly (7).

2 Apply adhesive (Item 3, App. C) to cushioning pad (18) and cupola body assembly (19). Allow to set for 15 minutes, then cement cushioning pad (18) to cupola body assembly (19).

NOTE

- Slot on inside of each ring must be in line when rings are assembled.
- Coat outer race ring (17) and upper (inner) ring (14) with solid film lubricant (Item 12, App. C) before installing lower race ring (11).

3 Install outer race ring (17), 12 new lock washers (16) and 12 screws (15). Torque screws to 38 lb-ft (51.5N.m).

4 Install upper (inner) ring (14) and 128 cream, white or yellow balls (12) alternately with 128 pink or red balls (13).

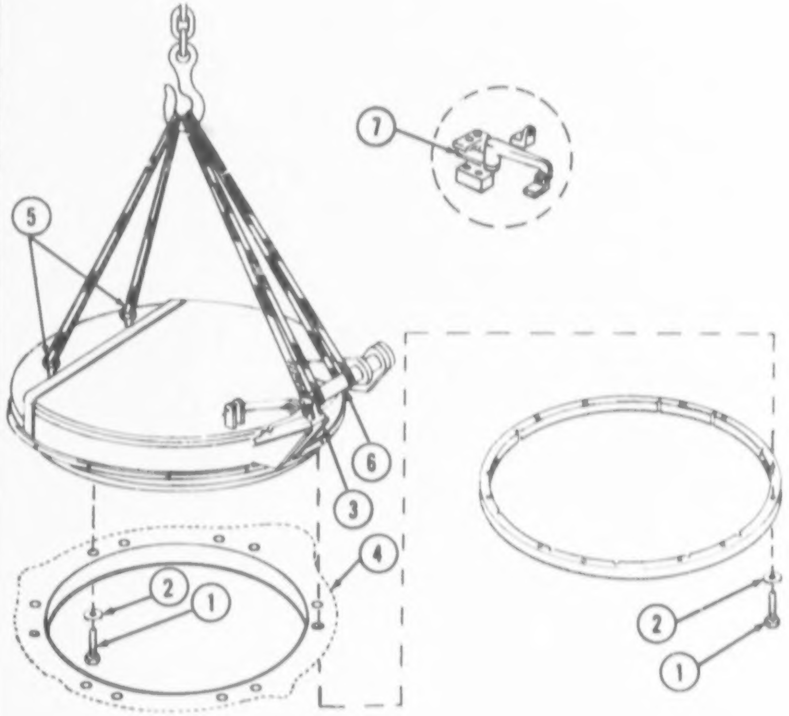
5 Install lower race ring (11) and 12 screws (10). Torque screws (9) to 35 lb-ft (47.5 N.m).

6 Install race ring shield (9) and 10 screws (8).

COMMANDER'S CUPOLA — Continued

10-2. CUPOLA RACE RING — Continued

e. Installation



WARNING

Cupola weighs 360 pounds (163.4 kilograms). Use hoist and sling capable of lifting 1000 pounds (454 kilograms) to provide adequate lifting capacity and prevent injury.

NOTE

Cupola on later design vehicles does not have the outside latch handle (7) pictured here.

1 Attach two eyebolts (5) to cupola (3) in screw holes for machinegun support.

2 Attach sling to two eyebolts (5) and hinge tube cover (6).

3 Attach hoist to sling. Lower cupola (3) into position on cab.

4 Install 12 flat washers (2) and 12 screws (1), attaching cupola (3) to cab (4). Torque screws to 360 lb-ft (488 N·m).

5 Install machinegun support (ref. TM 9-2350-311-20-2).

CHAPTER 11 TRUNNION SUPPORT BRACKET

GENERAL

This chapter illustrates and provides removal and installation procedures for the howitzer trunnion support bracket. These maintenance procedures are functions authorized for direct and general support level maintenance.

Title	Page
TRUNNION SUPPORT BRACKET	11-2

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TRUNNION SUPPORT BRACKET — Continued

This task covers: a. Removal b. Installation

INITIAL SET-UP

Materials/Parts
Lock wire

Special Tools
Lifting eye, threaded (Item 13, App. B)
Hoist, sling with three hooks
Strap
Fabricated mount cradle tripod (App. E) or wooden blocks
Fabricated cannon tube hydraulic tripod (App. E) or wooden blocks

Personnel Required
2

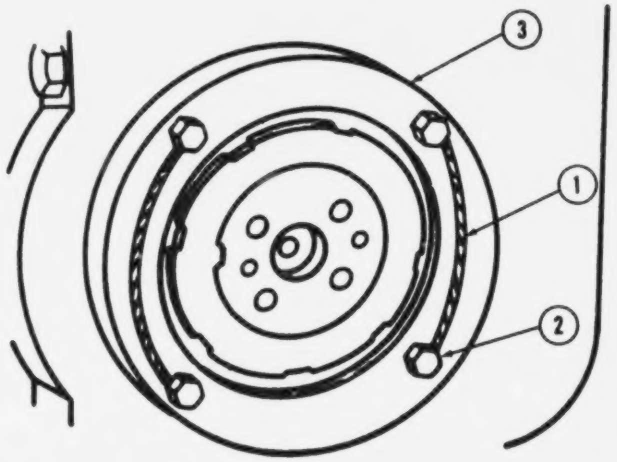
WARNING

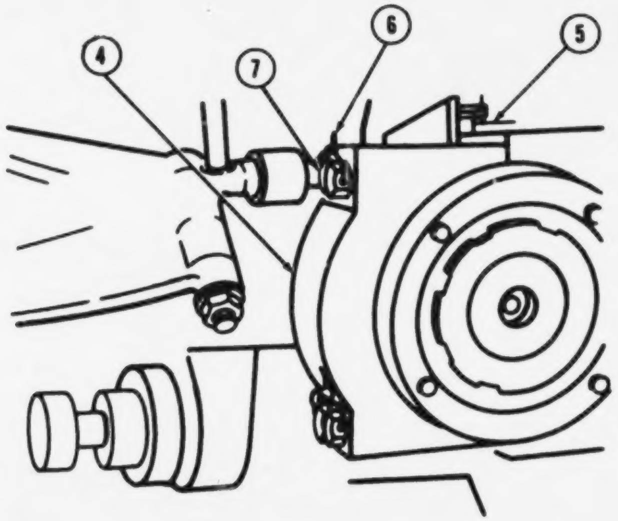
To prevent injury, personnel should wear steel-tipped safety shoes and gloves.

NOTE

Before trunnion support bracket is removed from cannon and mount, cannon, mount and trunnion bracket assembly must be removed from cab. Cannon, mount and trunnion bracket assembly must rest either on fabricated mount cradle tripod and cannon tube hydraulic tripod (App. E), or on wooden blocks (ref. page 4-2).

a. Removal





1 Remove two lock wires (1) and four screws (2). Discard two lock wires.

2 Remove bearing retainer (3).

3 Mark trunnion bearing cap (4) and trunnion support bracket (5). Bearing cap (4) is matched to trunnion support bracket (5) and must be installed on same side from which it was removed.

4 Remove two lock wires (6) and four screws (7). Discard two lock wires (6).

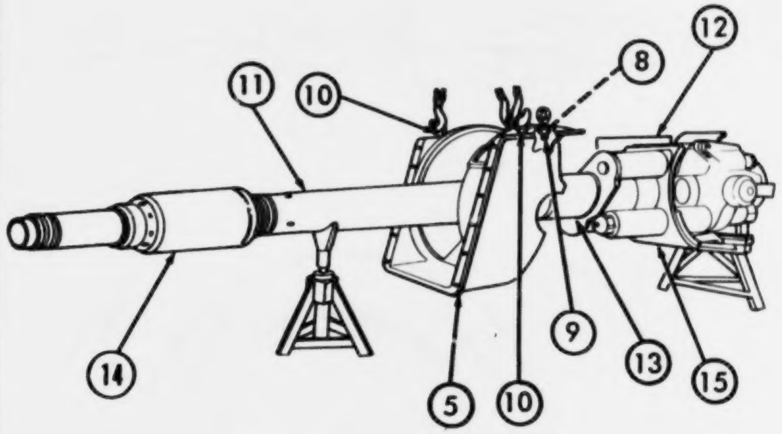
NOTE

Repeat steps 1 through 4 on remaining trunnion bearing cap.

5 Remove two trunnion bearing caps (4).

TRUNNION SUPPORT BRACKET — Continued

a. Removal-Continued



6 Install threaded lifting eye (Item 13, App. B) in top center hole (8) in trunnion support bracket (5). Fasten lifting eye (Item 13, App. B) with nut (9).

7 Attach lifting sling or chain (Item 5, App. B) to two fixed lifting eyes (10) and threaded lifting eye (Item 13, App. B).

8 Raise bracket (5) slightly off bearings and move it forward along cannon tube (11). Use care in clearing variable recoil cover and housing group (12), dust shield (13) and bore evacuator (14).

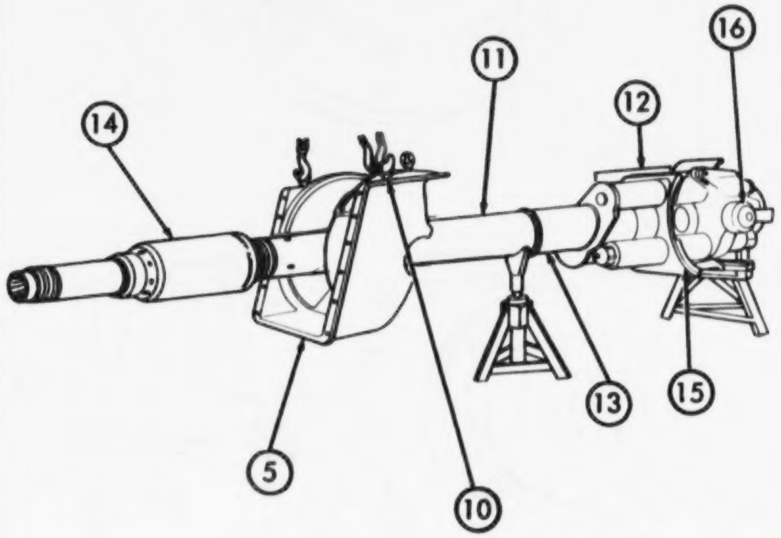
CAUTION

To prevent damage to polished and finished surfaces, do not place tripod beneath bore evacuator or any other machined surface.

9 Using bracket (5) to support cannon tube (11), reposition hydraulic tripod (App. E) towards muzzle end of cannon tube. Raise hydraulic tripod to support cannon tube (11).

10 Slide bracket (5) toward muzzle end of cannon tube (11). As bracket (5) moves toward muzzle end of tube (11), reposition hydraulic tripod (App. E) between bracket (5) and cradle (15) on a smooth portion of cannon tube (11).

b. Installation



NOTE

Before trunnion support bracket is installed on cannon and mount, cannon and mount must be resting on hydraulic tripod and mount cradle tripod or wooden blocks.

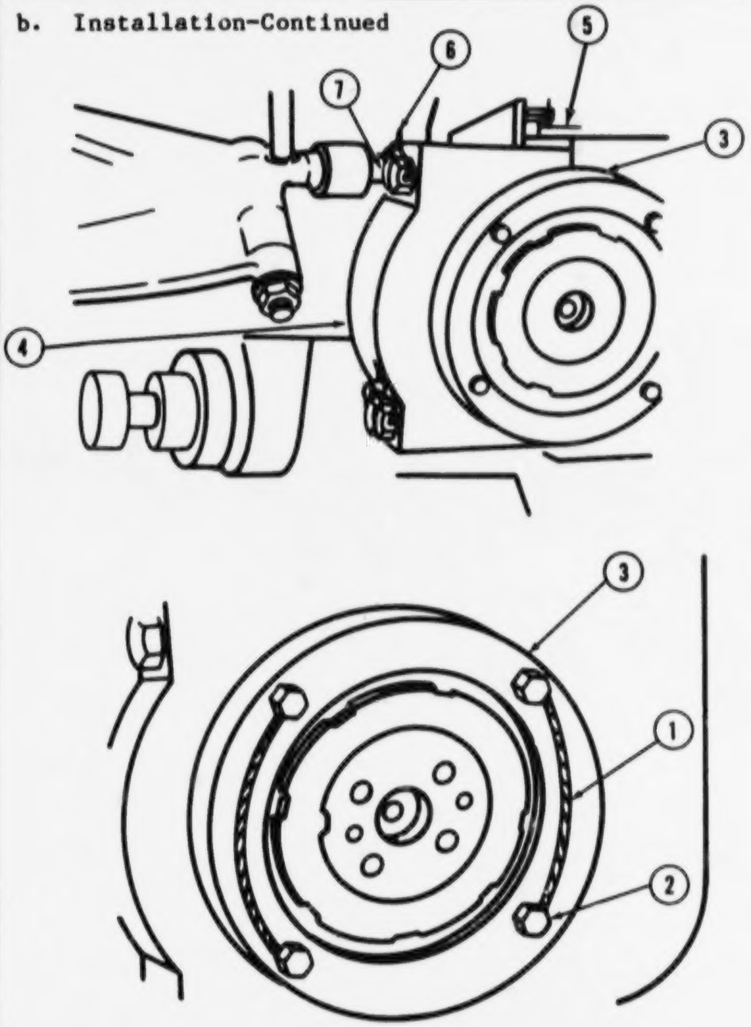
1 Raise bracket (5) and slide over muzzle end of cannon tube (11) towards breech end.

2 As bracket (5) nears hydraulic tripod (App. E), support cannon tube (11) using bracket (5) and reposition hydraulic tripod (App. E) towards muzzle end of cannon tube (11) on a smooth portion of the cannon tube (11).

3 Move bracket (5) along cannon tube (11) toward cradle (15). Set in place on trunnion bearings (16). Use care in clearing bore evacuator (14), dust shield (13) and variable recoil cover and housing group (12).

TRUNNION SUPPORT BRACKET — Continued

b. Installation-Continued



4 Install trunnion bearing cap (4). Trunnion bearing caps (4) are matched to trunnion support bracket (5). Each trunnion bearing cap (4) must be installed at the side of bracket (5) from which it was removed.

5 Install four screws (7). Torque to 425-450 lb-ft (576-610 N·m) and secure with two lock wires (6).

6 Install bearing retainer (3).

7 Install four screws (2). Torque to 90 lb-ft (122 N·m) and secure with two new lock wires (1).

NOTE

Repeat steps 4 through 7 on remaining trunnion bearing cap.

CHAPTER 12 CAB AMMUNITION RACK ASSEMBLY

GENERAL

This chapter describes and illustrates removal and installation procedures for cab ammunition rack assembly. These maintenance procedures are functions authorized for direct and general support level maintenance.

Title	Page
CAB AMMUNITION RACK ASSEMBLY	12-2

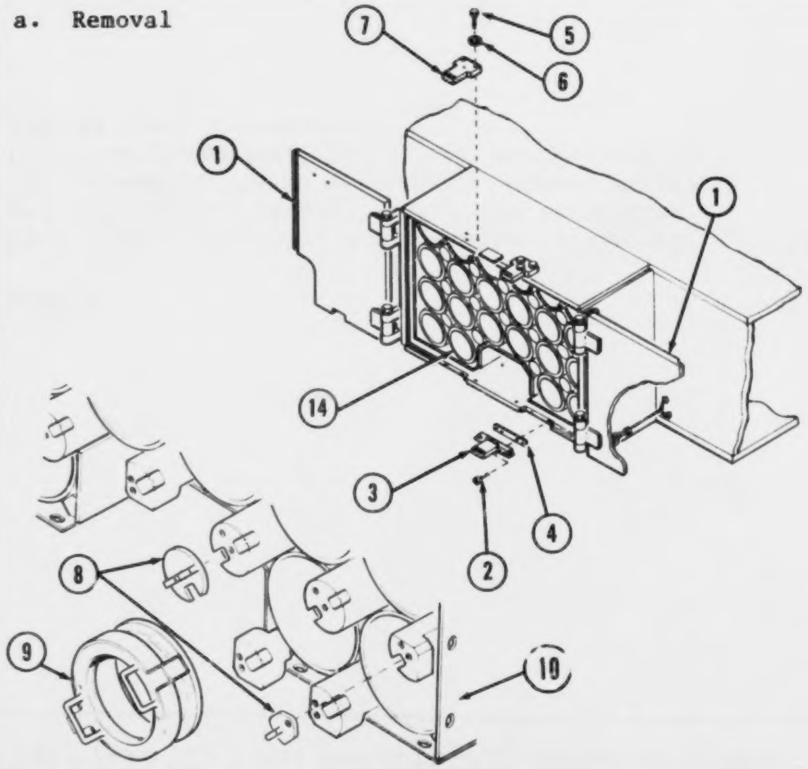
CAB AMMUNITION RACK ASSEMBLY — Continued

This task covers: a. Removal b. Installation

INITIAL SET-UP

Special Tools		Personnel Required
Ammunition rack removal and lifting tool (fabricated) (App. E)	Sling (Item 5, App. B) Hoist (Item 2, App. B)	3

a. Removal



WARNING

Weight of lifting rack is 960 pounds (436 kilograms). Personnel should wear steel-tipped safety shoes, safety glasses and gloves to avoid injury. Exercise caution when handling lifting rack.

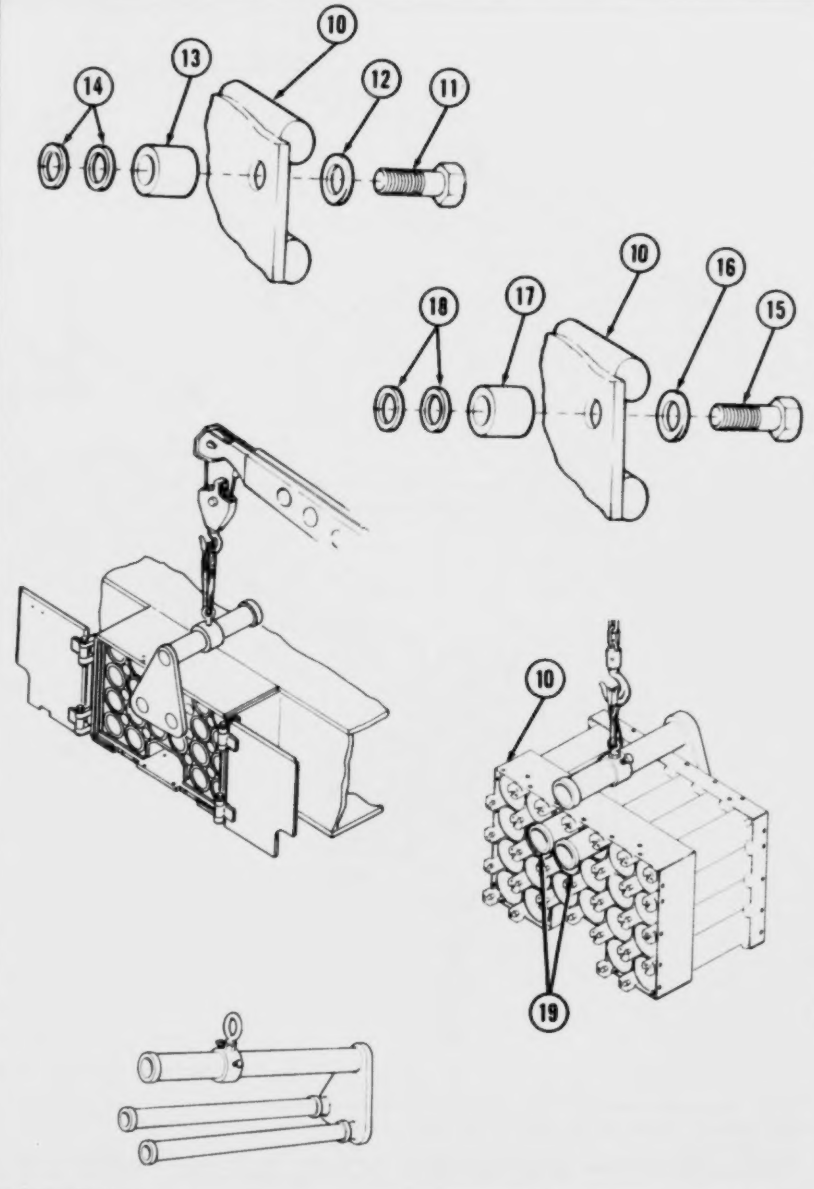
1 Open two bustle doors (1) and secure.

2 Remove eight bolts (2), two strike plates (3) and two shims (4) from bottom of two bustle doors (1).

3 Remove six screws (5), six flat washers (6) and two strike plates (7) from top of two bustle doors (1).

4 Rotate 31 locking caps (8) to OPEN position. (Locks located on rack inside cab).

5 Remove 22 retainers (9) from ammunition stowage rack (10).



6 Remove 22 screws (11), 22 flat washers (12), 16 spacers (13) and 16 shims (14) from ammunition stowage rack (10) perimeter. (Access to screws (11) inside cab.)

7 Remove 18 screws (15), 18 flat washers (16), 16 spacers (17) and 16 shims (18) (ref. page 12-5), from ammunition stowage rack (10) rear perimeter. (Access to screws (15) outside of bustle.)

8 Insert ammunition stowage rack removal and lifting tool (App. E) into 3d and 4th projectile tubes (19) on top row of ammunition stowage rack (10).

CAUTION

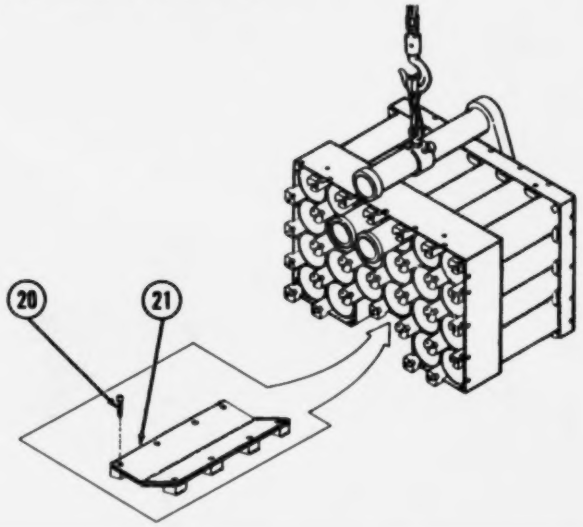
Use two personnel to guide ammunition stowage rack during removal to prevent damage to ammunition stowage rack or bustle.

9 Attach sling (Item 5, App. B) and hoist (Item 2, App. B) or wrecker to ammunition stowage rack removal and lifting tool (App. E).

10 Raise hoist (Item 2, App. B) or move wrecker to take up weight of ammunition stowage rack (10). Lift ammunition stowage rack (10) out of bustle.

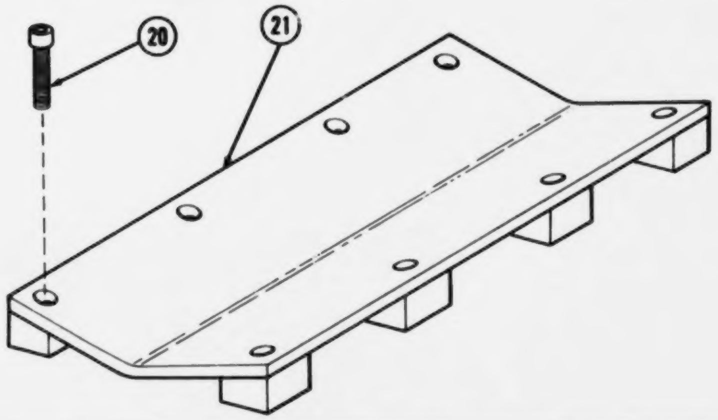
CAB AMMUNITION RACK ASSEMBLY — Continued

a. Removal-Continued



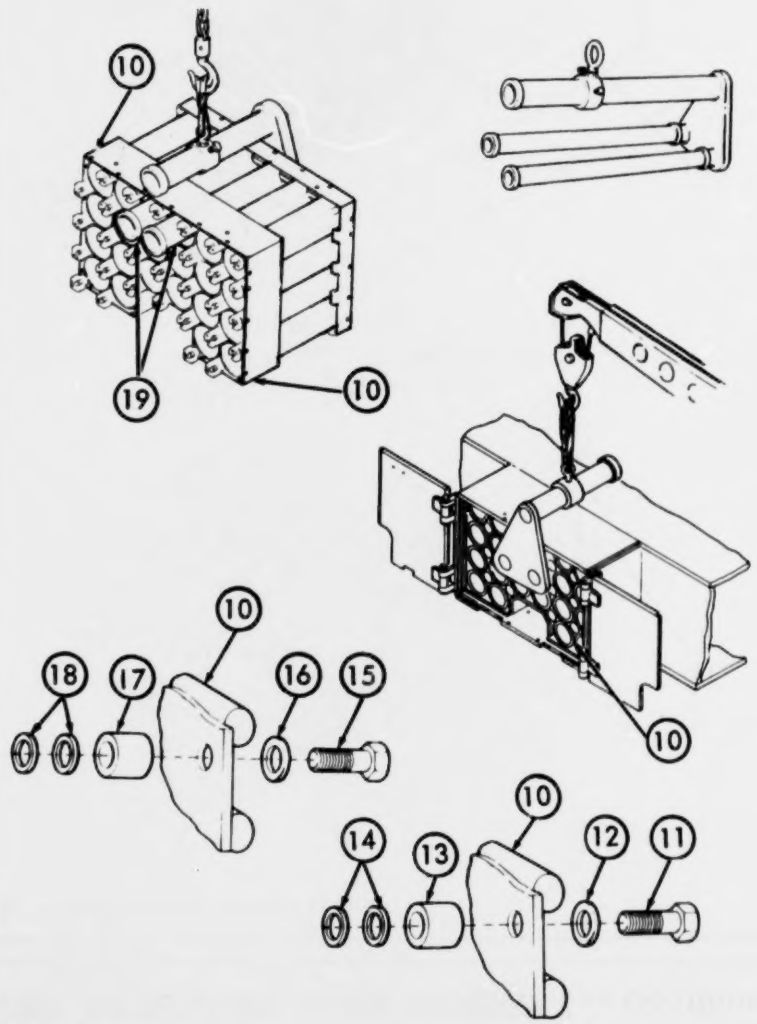
11 Remove eight screws (20) and wear plate (21) from bustle.

b. Installation



WARNING

Weight of lifting rack is 960 pounds (436 kilograms). Personnel should wear steel-tipped safety shoes, safety glasses and gloves to avoid injury. Exercise caution when handling lifting rack.



1 Install wear plate (21) and eight screws (20) onto bustle.

2 Insert ammunition stowage rack removal and lifting tool (App. E) in 3d and 4th projectile tubes (19) on top row of ammunition stowage rack (10) (ref. page 12-3).

3 Attach sling (Item 5, App. B) and hoist (Item 2, App. B) or wrecker to ammunition stowage rack removal and lifting tool (App. E).

4 Raise hoist (Item 2, App. B) to take up weight of ammunition stowage rack (10). Move hoist (Item 2, App. B) or drive wrecker to position ammunition stowage rack (10) into bustle.

CAUTION

Use two personnel to guide ammunition stowage rack during installation to prevent damage to ammunition stowage rack or bustle.

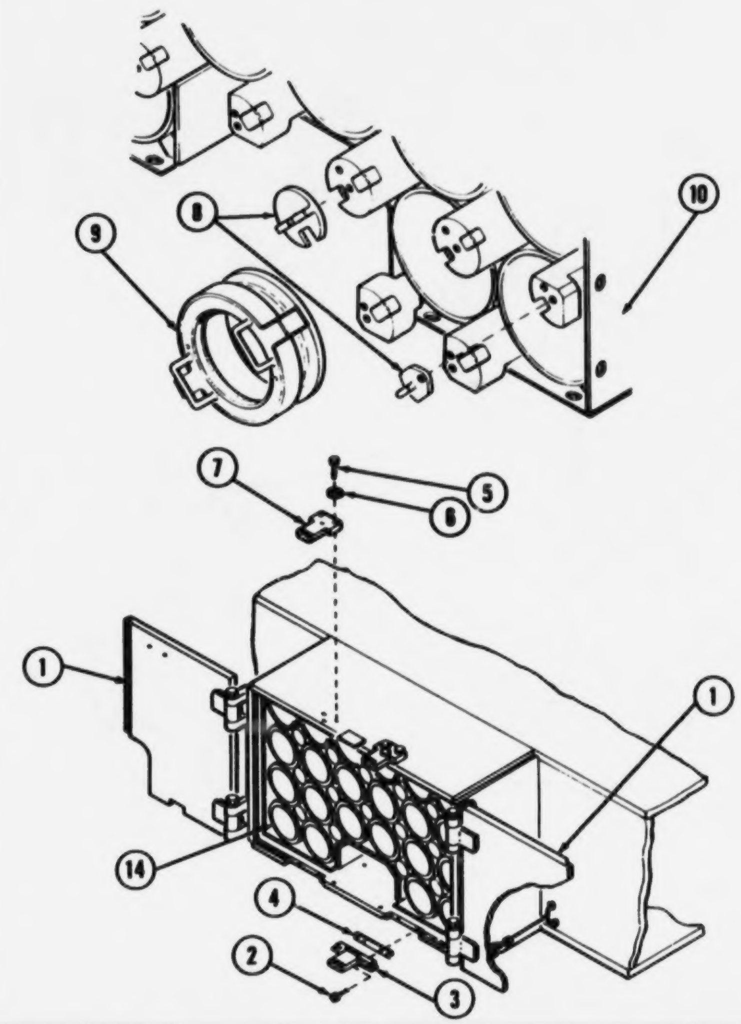
5 Push ammunition stowage rack (10) into bustle.

6 Install 16 shims (18) as required, 16 spacers (17), 18 flat washers (16) and 18 screws (15) into ammunition stowage rack (10) rear perimeter. (Screws (15) installed from outside bustle.)

7 Install 16 shims (14), as required, 16 spacers (13), 22 flat washers (12) and 22 screws (11) into ammunition stowage rack (10) perimeter. (Screws (10) installed from inside cab.)

CAB AMMUNITION RACK ASSEMBLY — Continued

b. Installation-Continued



8 Install 22 retainers (9) into ammunition stowage rack (10).

9 Rotate 31 locking caps (8) to CLOSED position. (Locks located inside cab).

10 Install two strike plates (7), six flat washers (6) and six screws (5) into top of two bustle doors (1).

11 Install two shims (4) as required, two strike plates (3) and eight bolts (2) into bottom of two bustle doors (1).

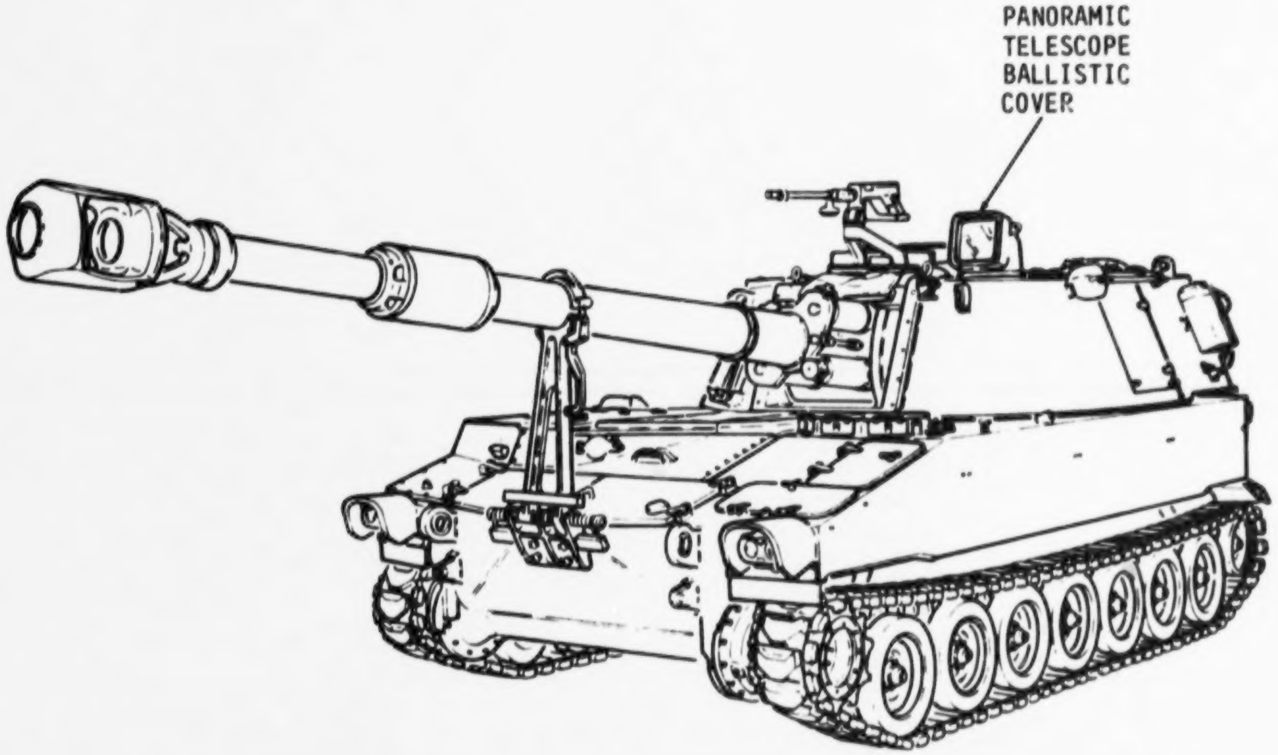
12 Close two bustle doors (1).

CHAPTER 13 PANORAMIC TELESCOPE BALLISTIC COVER

GENERAL

This chapter illustrates and describes replacement and repair of panoramic telescope ballistic cover.

Title	Page
PANORAMIC TELESCOPE BALLISTIC COVER	13-2


PANORAMIC
TELESCOPE
BALLISTIC
COVER

EXTERIOR LEFT SIDE VIEW

PANORAMIC TELESCOPE BALLISTIC COVER — Continued

This task covers: a. Removal b. Disassembly c. Inspection and Repair
d. Assembly e. Installation

INITIAL SET-UP

Materials/Parts

- Sealing compound, grade EV, liquid, purple (Item 23, App. C)
- Adhesive, Type II (Item 3, App. C)
- Lubricant, solid film (Item 12, App. C)
- Gaskets
- Grooved pins

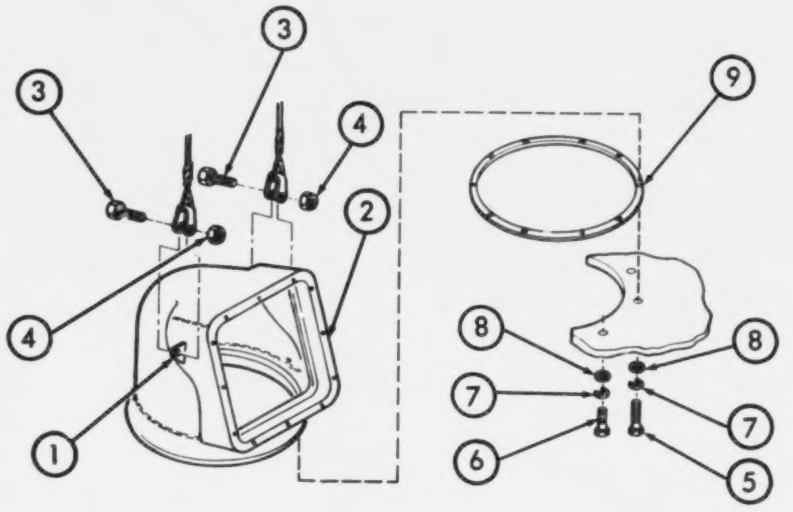
Special Tools

- Clevises
- 1/2-inch bolts
- 1/2-inch nuts
- Hoist and cables

Personnel Required

2

a. Removal



NOTE

- Before beginning removal procedure, cover window of cover to prevent scratches or damage.
- Use longitudinal locking knob to move ballistics mount to gain access to two front bolts.

1 Attach two lifting cables of hoist to two lugs (1) on cover (2) with two clevises, two bolts (3) and two nuts (4).

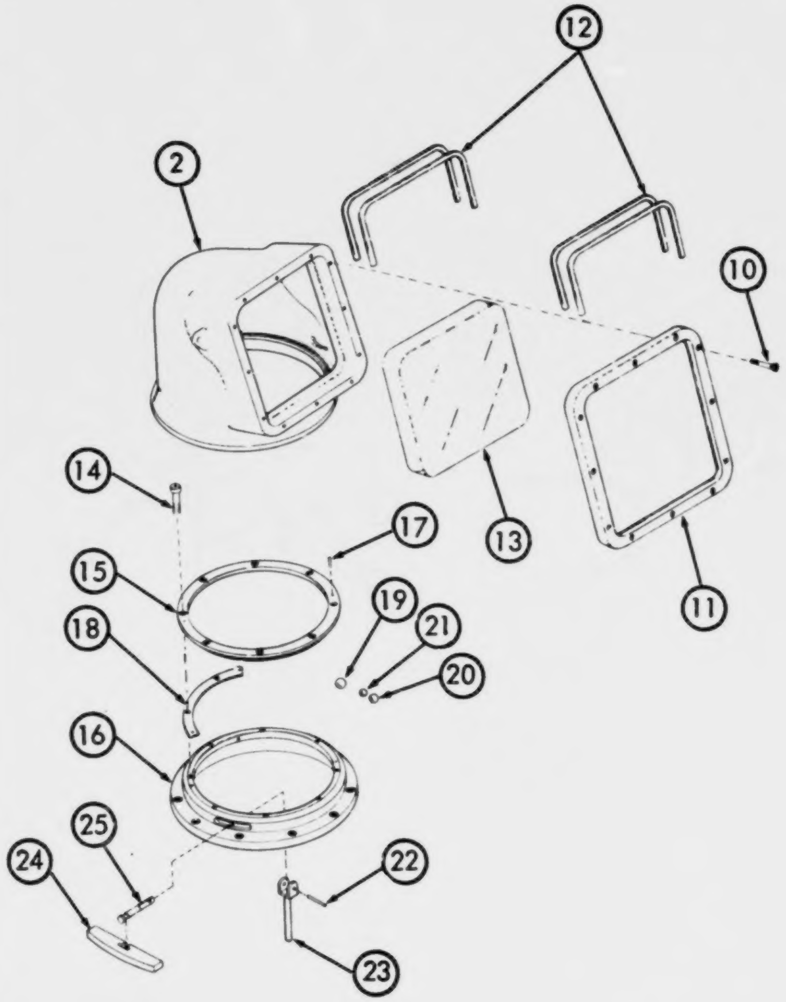
2 From inside cab, remove eight long bolts (5), two short bolts (6), ten lock washers (7) and ten flat washers (8).

3 Lift cover (2) away from roof of cab.

4 Remove and discard gasket (9).

PANORAMIC TELESCOPE BALLISTIC COVER — Continued

b. Disassembly



1 Remove twelve self-locking screws (10), spacer plate (11), two gaskets (12) and window (13) from cover (2). Discard two gaskets (12).

2 Remove eight socket cap screws (14) from upper ring (15).

3 Separate upper ring (15) from lower ring (16) enough so that two alinement pins (17) clear lower ring (16).

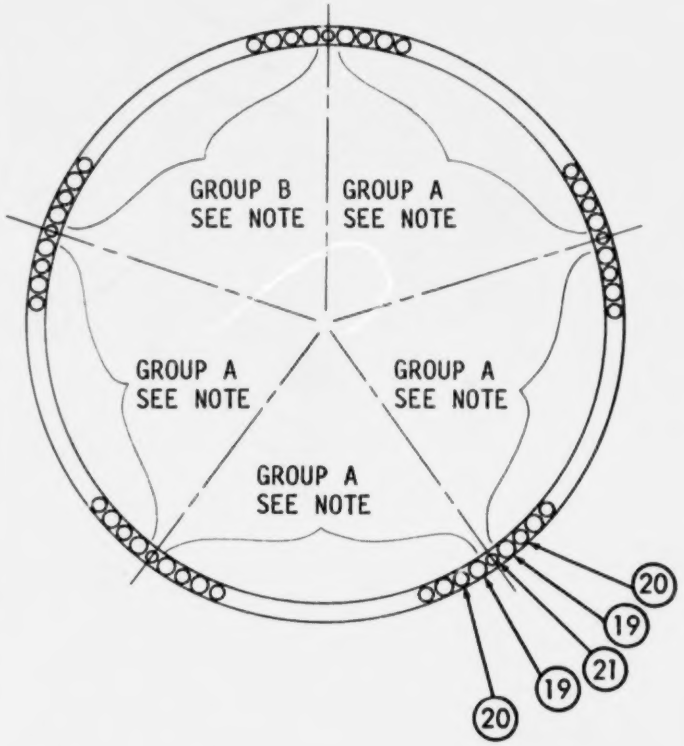
4 Lift cover (2) off of ring assembly. (Upper ring (15) may stick in cover (2).)

5 Remove upper ring (15) and shim(s) (18), if used, from lower ring (16). Tie shim(s) (18) together and save for use in assembly.

6 58 large phenolic balls (19), 54 medium phenolic balls (20) and five small steel balls (21) will fall from ring assembly when cover (2) is lifted. Save all balls (19, 20, and 21) for use in assembly.

7 Remove two grooved pins (22), two rod end clevises (23), two brake shoes (24) and two bolts (25). Discard grooved pins.

c. Inspection and Repair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20

1 Clean all parts (ref. page 2-18 and 2-19).

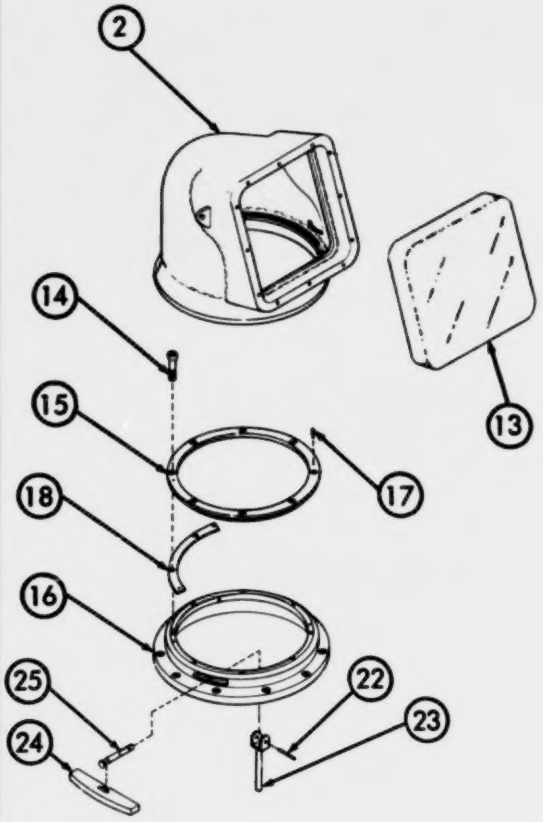
2 Inspect and measure 58 large phenolic balls (19) for scoring or other damage. These balls are white, off-white or yellow in color. Replace any large phenolic ball (19) that has an outside diameter less than 0.4058 inch (10.3 mm).

3 Inspect and measure 54 medium phenolic balls (20) for scoring or other damage. These balls are red or pink in color. Replace any medium phenolic ball (20) that has an outside diameter less than 0.3917 inch (9.5 mm).

4 Inspect five small steel balls (21) for scoring or other damage. Replace as required.

PANORAMIC TELESCOPE BALLISTIC COVER — Continued

c. Inspection and Repair-Continued



NOTE

Upper ring and lower ring must be replaced as a matched set.

5 Inspect cover (2), upper ring (15) and lower ring (16). Replace if cracked or distorted.

6 Inspect threaded holes of cover (2) and lower ring (16). Repair threads if damaged.

7 Inspect window (13). Replace if scratched, cracked or difficult to see through.

8 Inspect two alinement pins (17). Replace if bent, cracked or otherwise damaged.

d. **Assembly**

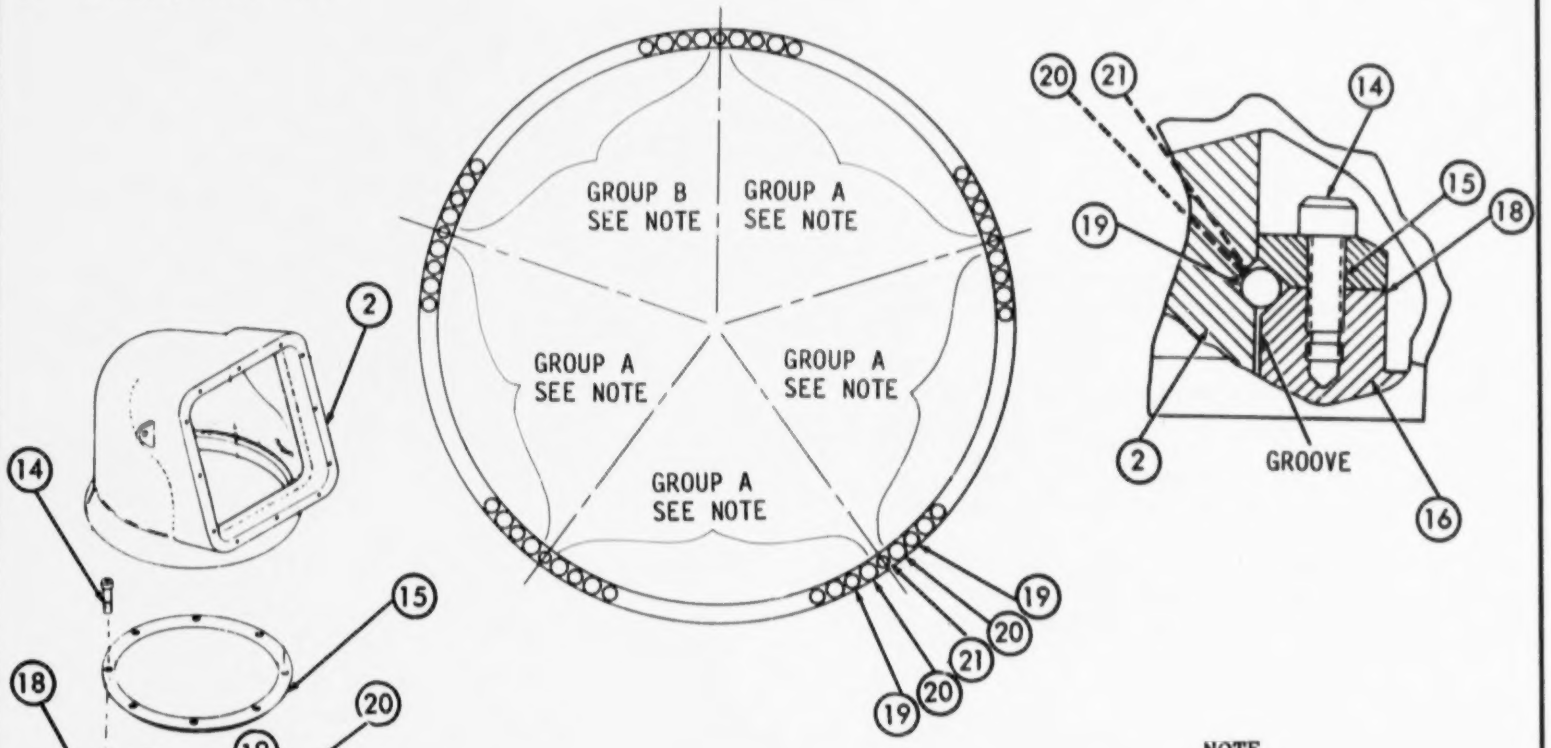
1 Install two bolts (25), two brake shoes (24), two rod end clevises (23) and two new grooved pins (22) in lower ring (16).

2 Place upper ring (15) and shim(s) (18) on lower ring (16). Make sure two alinement pins (17) are engaged in holes of lower ring (16) and holes in shim(s) (18) are alined with holes in lower ring (16) and upper ring (15).

3 Place cover (2) over ring assembly. Do not install eight socket cap screws (14) yet.

PANORAMIC TELESCOPE BALLISTIC COVER — Continued

d. Assembly-Continued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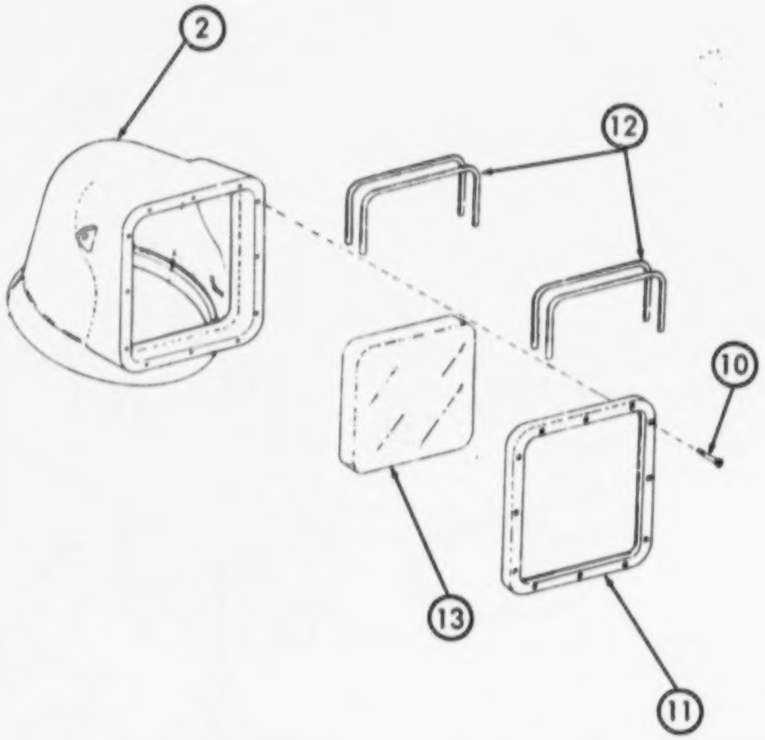
NOTE

- Group A consists of 23 phenolic balls alternating between 12 large balls and 11 medium balls.
- Group B consists of 20 phenolic balls alternating between 10 large balls and 10 medium balls.



4 Apply a coating of solid film lubricant (Item 12, App. C) to ball bearing groove.

5 Raise upper ring (15) from lower ring (16). Insert five small steel balls (21), 54 medium phenolic balls (20) and 58 large phenolic balls (19) in five groups as shown on page 13-8. All balls (21, 20, and 19) must be completely in groove formed by lower ring (16) and cover (2).

6 Install upper ring (15) and shim(s) (18) on lower ring (16) and secure with eight socket cap screws (14). Torque socket cap screws (14) to 34-42 lb-ft (46-57 N·m).

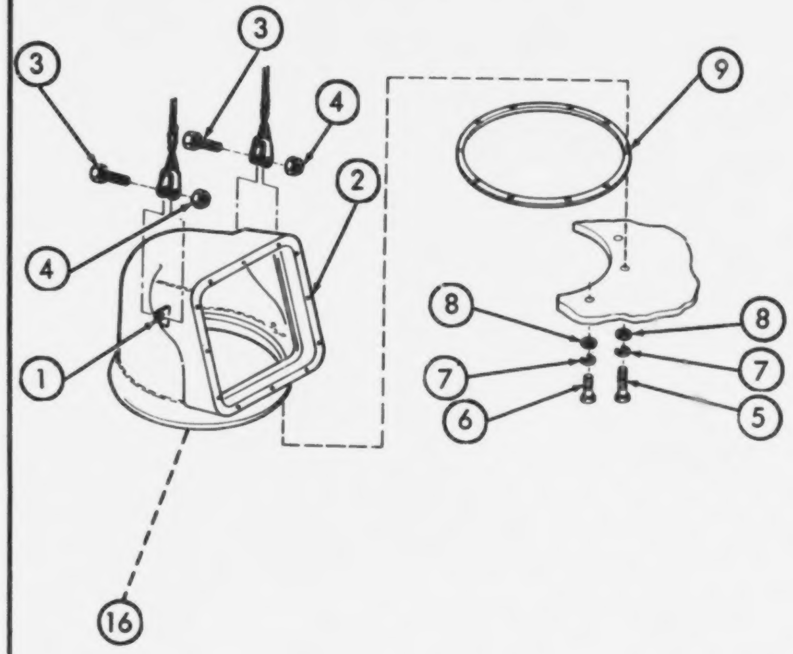
7 Rotate cover (2) to check operation. If cover (2) binds, add shim(s) (18) as required to obtain smooth rotation.

8 Install two new gaskets (12) and window (13). Small plate of window (13) must face inside cover (2) and etched trademark or number on glass must face outward.

9 Apply sealing compound (Item 23, App. C) to edges of spacer plate (11) which meet cover (2). Install two new gaskets (12), spacer plate (11) and twelve self-locking screws (10). Torque self-locking screws (10) to 7-8 lb-ft (9-10 N·m).

PANORAMIC TELESCOPE BALLISTIC COVER — Continued

e. Installation



1 Make sure that all remnants of old gasket (9) have been removed from cab roof. Apply adhesive Type II (Item 3, App. C) to new gasket (9) and install on cab roof, alining holes.

2 Attach two lifting cables of hoist to two lugs (1) on cover (2) with two clevises, two bolts (3) and two nuts (4).

3 From inside cab, insert two long bolts (5), two lock washers (7) and two flat washers (8) to serve as locators. Hold in position until step 4 is completed.

4 Lower cover (2) onto seal, alining holes in lower ring (16) with two long bolts (5). Install remaining six long bolts (5) with six lock washers (7) and six flat washers (8). Install two short bolts (6), two lock washers (7) and two flat washers (8) in two front holes in cab roof. Torque all bolts (5 and 6) to 72-88 lb-ft (97-119 N·m).

5 Check rotation of cover (2).

6 Remove two nuts (4), two bolts (3), two clevises and two lifting cables of hoist.

APPENDIX A REFERENCES

A-1. PUBLICATIONS INDEXES

The following publications constitute a listing of forms and publications applicable to maintenance for materiel covered in this technical manual. Appropriate indexes should be consulted frequently for latest applicable changes, revisions and additions.

DA PAM 108-1
Index of Army Motion Pictures and related audio visual aids.
DA PAM 310-1
Consolidated Index of Publications and Blank Forms
DA PAM 750-33
Charging System Troubleshooting

A-2. REGULATIONS

AR 75-1
Malfunctions Involving Ammunition and Explosives
AR 310-25
Dictionary of United States Army Terms
AR 310-50
Authorized Abbreviations and Brevity Codes
AR 385-40
Accident Reporting and Records
AR 385-55
Prevention of Motor Vehicle Accidents
AR 700-58
Packing Improvement Report
AR 725-50
Requisitioning Receipt and Issue System
AR 735-11-2
Reporting of Item and Packaging Discrepancies
AR 746-1
Packaging of Army Materiel for Shipment and Storage
AR 750-1
Army Materiel Maintenance Concepts and Policies
AR 750-51
Maintenance Assistance and Inspection (MAIT) Program
FM 9-207
Operation and Maintenance of Ordnance Materiel in Cold Weather
FM 31-70
Basic Cold Weather Manual

A-3. FORMS

DA Form 2028
Recommended Changes to Publications
SF Form 364
Report of Deficiencies
SF Form 368
Quality Deficiency Report

REFERENCES – Continued

A-4. MANUALS

DA PAM 738-750
The Army Maintenance Management System (TAMMS)
FM 9-207
Operation and Maintenance of Ordnance Materiel in Cold Weather
FM 21-11
First Aid for Soldiers
LO 9-2350-311-12
Lubrication Order for Howitzer, Medium, Self Propelled: M109A2/A3
SB 7-1
Storage and Supply Activities, Covered and Open Storage
SB 710-1-1
Standard Study Number System and Replacement Factors
SB 740-1
Storage and Supply Activities, Covered and Open Storage
SB 740-98-1
Storage Serviceability Standard: Tracked Vehicles, Wheeled Vehicles and Component Parts
SC 4933-95-CL-E19
Tool Kit, Field Artillery Repairman: Armament, Basic (NSN 4933-00-332-4204) and Tool Kit: Field Artillery Repairman: Armament Contact and Emergency Repair (NSN 4933-00-332-4203)
SC 5180-95-CL-A51
Tool Kit, Turret Mechanic's (NSN 5180-00-695-0139)
TB ORD 426
Hydropneumatic Recoil Mechanisms for Towed and Self-Propelled Field Artillery
TB SIG-222
Solder and Soldering
TB 9-1000-234-30
Exercising of Recoil Mechanisms and Equilibrators
TB 9-2300-281-35
Standards For Overseas Shipment or Domestic Issue of Combat, Tactical and Special Purpose Vehicles, Construction and Selected Industrial and Troop Support Items
TM 9-214
Inspection, Care and Maintenance of Anti-Friction Bearings
TM 9-237
Operator's Manual: Welding Theory and Application
TM 9-254
General Maintenance Procedures for Fire Control Materiel
TM 9-1000-202-14
Evaluation of Cannon Tubes
TB 9-1005-213-10
Operator's Manual: Machinegun, cal. 50 Browning, Heavy Barrel, Flexible
TM 9-1005-213-25
Organizational, DS, GS and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Machinegun, cal. 50, Browning, M2, Heavy Barrel Flexible

TM 9-1240-273-34
Field Maintenance Manual, Telescope Mount M145
TM 9-1240-274-34
Direct and General Support Maintenance Manual, Panoramic Telescope M117/M117A2
TM 9-1240-275-34
Field Maintenance Manual, Telescope Mount M146
TM 9-1240-276-34
Direct and General Support Maintenance Manual, Elbow Telescope M118A2
TM 9-1290-322-35
Direct Support, General Support and Depot Maintenance Manual, Quadrant Fire Control, Elevation M15
TM 9-2350-311-10
Operator's Manual: Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-HR
Hand Receipt for Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-20-1
Organizational Maintenance Manual for Hull, Powerplant, Drive Controls, Tracks, Suspension and Associated Components, Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-20-2
Organizational Maintenance Manual for Cab, Armament, Sighting and Fire Control, Elevating Traversing Systems and Associated Components, Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-20P-1
Organizational Maintenance Repair Parts and Special Tools List: Hull, Powerplant, Drive Controls, Tracks, Suspension and Associated Components, Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-20P-2
Organizational Maintenance Repair Parts and Special Tools List: Cab Armament, Sighting and Fire Control, Elevating, Traversing Systems and Associated Components Used on Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-34-1
Direct Support and General Support Maintenance Manual for Hull, Suspension, Final Drive and Miscellaneous Components, Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-34P-1
DS and GS Maintenance Repair Parts and Special Tools Lists for Hull Powerplant, Drive Control, Tracks, Suspension and Associated Components, Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-2350-311-34P-2
Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Cab, Armament, Sighting and Fire Control, Elevating, Traversing Systems and Associated Components, Howitzer, Medium, Self-Propelled: 155MM, M109A2/A3
TM 9-4933-200-35
Direct Support, General Support and Depot Maintenance Manual for Pullover Gages and Borescopes M1 and M2
TM 38-230-1
Preservation, Packaging and Packing of Military Supplies and Equipment (Volume 1)
TM 38-230-2
Preservation, Packaging and Packing of Military Supplies and Equipment (Volume 2)

REFERENCES—Continued

A-4. MANUALS

TM 43-0139
Painting Instructions for Field Use
TM 740-90-1
Administrative Storage of Equipment
TM 743-200
Storage and Materiels Handling
TM 750-116
Organizational, Direct Support and General Support Maintenance Procedures for Purging and Charging of Fire Control Instruments
TM 750-138
Procedures for Rapid Deployment, Redeployment and Retrograde for Combat Vehicles
TM 750-244-6
Procedures for Destruction of Tank Automotive Equipment to Prevent Enemy Use

A-5. MILITARY AND FEDERAL SPECIFICATIONS

ANSI Y14.5-1973
Dimensioning and Tolerancing Drawings for Engineering
MIL-G-10924
Grease, Automotive and Artillery (GAA)
MIL-M10578
Corrosion Removing and Metal Conditioning Compound (phosphoric acid base)
MIL-W-5044
Walkway Compound and Matting, Nonslip
SC 4933-95-CL-E19
Tool Kit, Field Artillery Repairman: Armament, Basic (NSN 4933-00-332-4203) and Tool Kit, Field Artillery Repairman: Armament Contact and Emergency Repair (NSN 4933-332-4203)
SC 5180-95-CL-A51
Tool Kit, Turret Mechanic's (NSN 5180-695-9129)
TT-E-185
Enamel, Semi-Gloss, Rust Inhibiting
TT-E-529
Enamel, Alkyd, Semi-Gloss
TT-P-664
Primer, Coating, Synthetic, Rust Inhibiting, Lacquer-Resisting

APPENDIX B SPECIAL TOOLS AND EQUIPMENT

Special Tools and Handling Equipment

	Description	NSN and Part No.	Usage
1.	Adapter, Torque	5120-00-933-7357 10954669 (Mfg. code is added)	To check cab traversing mechanism clutch while in vehicle
2.	Hoist, Cab Lifting	3950-00-889-8746 MIL-H-904	To remove, install or lift cab
3.	Sling Assembly, Lifting Traverse Mechanism	4910-00-678-8414 10942192	To remove, install or lift cab traversing mechanism
4.	Sling Assembly, lifting Powerpack	4910-00-076-3104 10930417	To remove, install or lift hydraulic powerpack
5.	Sling, Cab Lifting	4910-00-776-8906 8387711	To raise cab from vehicle
6.	Sling, Gun Tube	4933-00-699-9307 8735440	To remove or install cannon
7.	Socket Wrench, Special	5120-00-976-3105 10930422	To remove or install hydraulic powerpack filter screen
8.	Wrench, pipe, chain-type	5120-00-866-5850	To remove cannon tube

APPENDIX B SPECIAL TOOLS AND EQUIPMENT

Special Tools and Handling Equipment

	Description	NSN and Part No.	Usage
9.	Extension Valve, Charging Accumulator	5120-00-051-5566 11605630	To allow charging of main accumulator while in vehicle
10.	Accumulator Charging Regulator	4910-00-861-2068 11615420	For charging accumulators
11.	Nitrogen Charging Kit	1025-01-070-3200 8449334	For charging accumluators
12.	Fire Control Purging and Charging Kit	4931-00-065-1110 SC4931-95CLJ54	For charging accumulators
13.	Eye Bolts		For lifting cab race ring assembly.

APPENDIX C EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST–Section I. Introduction

C-1. SCOPE

This appendix lists expendable/durable supplies and materiels needed to operate and maintain 155MM self-propelled howitzer at direct and general support levels. This listing is for informational purposes only. It is not authority to requisition listed items. These items are authorized by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts and Heraldic Items) or CTA 8-100, Army Medical Department Expendable/Durable Items.

C-2. EXPLANATION OF COLUMNS

a. Column (1)--Item Number. This number is assigned to entry in listing and is referenced in narrative instructions to identify materiel (e.g., "Use adhesive, Item 2, App. C").

b. Column (2)--Level. This column identifies lowest level of maintenance that requires listed item. DS/GS--Direct Support/General Support.

c. Column (3)--National Stock Number. This is National Stock Number (NSN) assigned to item. Use it to request or requisition item.

d. Column (4)--Description. Indicates federal item name and, if required, a description to identify item. The last line for each item indicates Federal Supply Code for Manufacturer (FSCM) in parentheses followed by part number.

e. Column (5)--Unit of Measure (U/M). Indicates measure used in performing actual maintenance function. This measure is expressed by two-character alphabetical abbreviation (e.g., ea, in, pr). If unit of measure differs from unit of issue, requisition lowest unit of issue that will satisfy your requirements.

APPENDIX C EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST – Section II. E/DSM List

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1		8040-00-800-1811	Adhesive, BB 2902, epoxy	PT
2		8040-00-270-8137	Adhesive, epoxy, Type I (MIL-A-8623A)	QT
3		8040-00-221-3811	Adhesive, Type II, MIL-S, reclaimed rubber, liquid, general purpose	OZ
4		8040-00-664-4318	Adhesive, Type II, MIL-S-5092	PT
5		8040-00-262-9205	Adhesive, Type II, MIL-S-5092	GL
5.1		8030-00-753-4953	Antiseize compound, MIL-A-13881 (80244)	LB
6		8030-00-064-4017	Corrosion preventive (fingerprint remover), MIL-C-15074	QT
7		6850-00-281-3061	Dry cleaning solvent, P-D-680	CN
8		9150-00-190-0917	Grease, graphite, soft, grade 1, W-G-671	CN
9		9150-00-190-0904	Grease, automotive and artillery, MIL-G-10924, Braycote 610 (98308)	LB
10		9150-00-935-9808	Hydraulic fluid, det., MIL-H-6083, Brayco 783C (98308)	GL
11		9150-00-231-6689	Lubricating oil, Gen. Pl. SPC, VV 1800 (81348)	QT
12		9150-00-948-6912	Lubricant, solid film, MIL-L-46010	QT

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
13		9150-00-257-5440	Lubricating oil, gear, MIL-L-10324	GL
14		9150-00-257-5443	Lubricating oil, gear, MIL-L-10324	DR
15		9150-00-754-2635	Lubricating oil, gear, MIL-L-2105 (use below 0°F)	QT
16		9150-00-905-9100	Lubricating oil, gear, MIL-L-2105 (use below 0°F)	GL
17		9150-00-577-5841	Lubricating oil, grade 90, with pressure additives, MIL-L-2105	GL
18		6800-00-264-9086	Nitrogen, BB-N-411, dry, high pressure	BT
19		8030-00-081-2333	Sealing compound, grade C, liquid, blue, MIL-S-22473	BT
20		8030-00-824-1384	Sealing compound, grade C, liquid, blue, MIL-S-22473	PT
21		8030-00-456-1039	Sealing compound, grade C, liquid, blue, MIL-S-22473	QT
22		8030-00-964-7537	Sealing compound, grade C, liquid, blue, MIL-S-22473	OZ
22.1		8030-00-058-5398	Sealing compound, grade CV, MIL-S-22473	CC
23		8030-00-081-2286	Sealing compound, grade EV, liquid, purple, MIL-S-22473	BT
24		8030-00-081-2326	Sealing compound, grade H, liquid, brown, MIL-S-22473	BT
24.1			Sealing compound, MIS-30042	
25		3439-00-247-6921	Solder, QQ-S-571 (81348)	LB

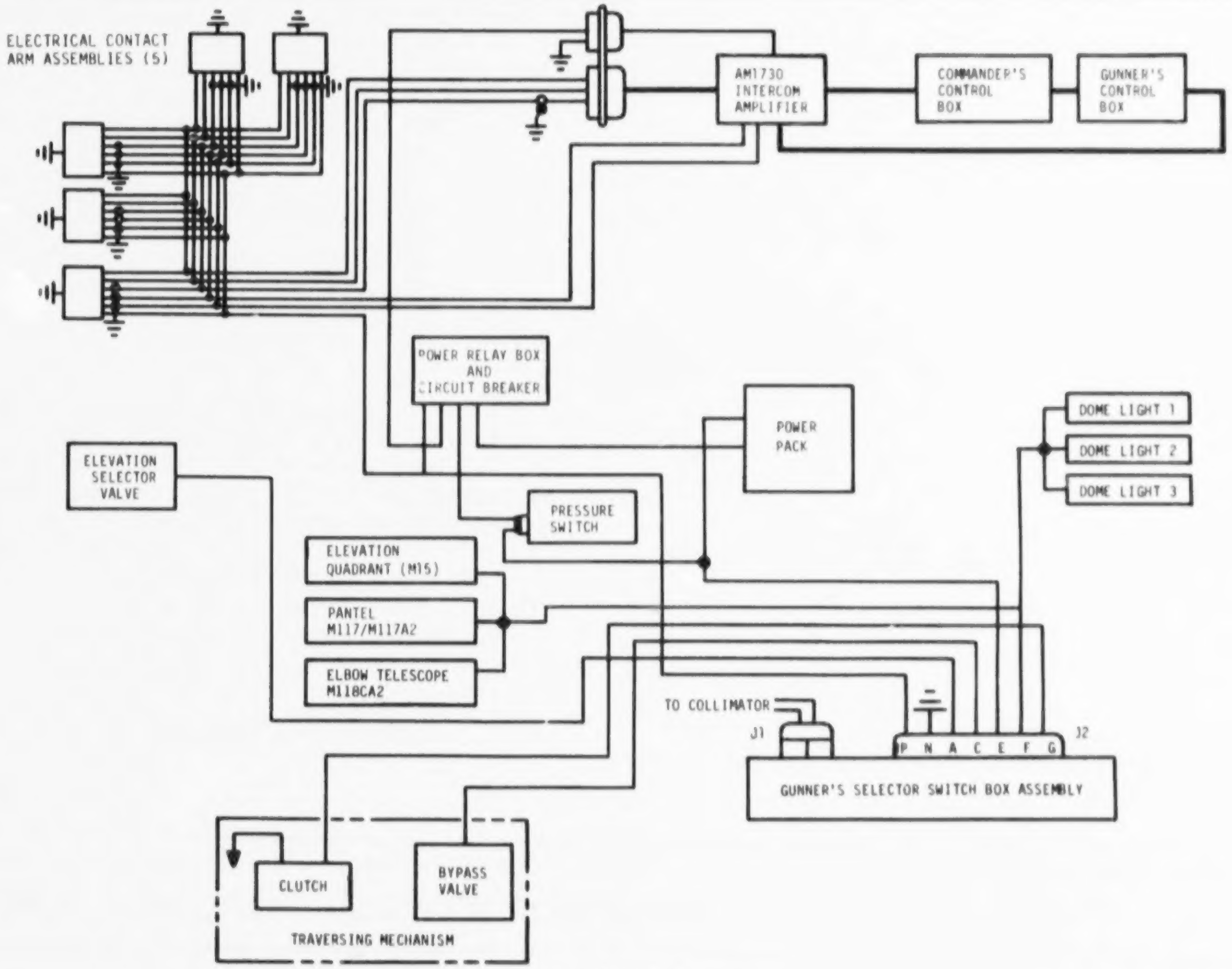
APPENDIX D ELECTRICAL/HYDRAULIC SCHEMATICS

D-1. INTRODUCTION

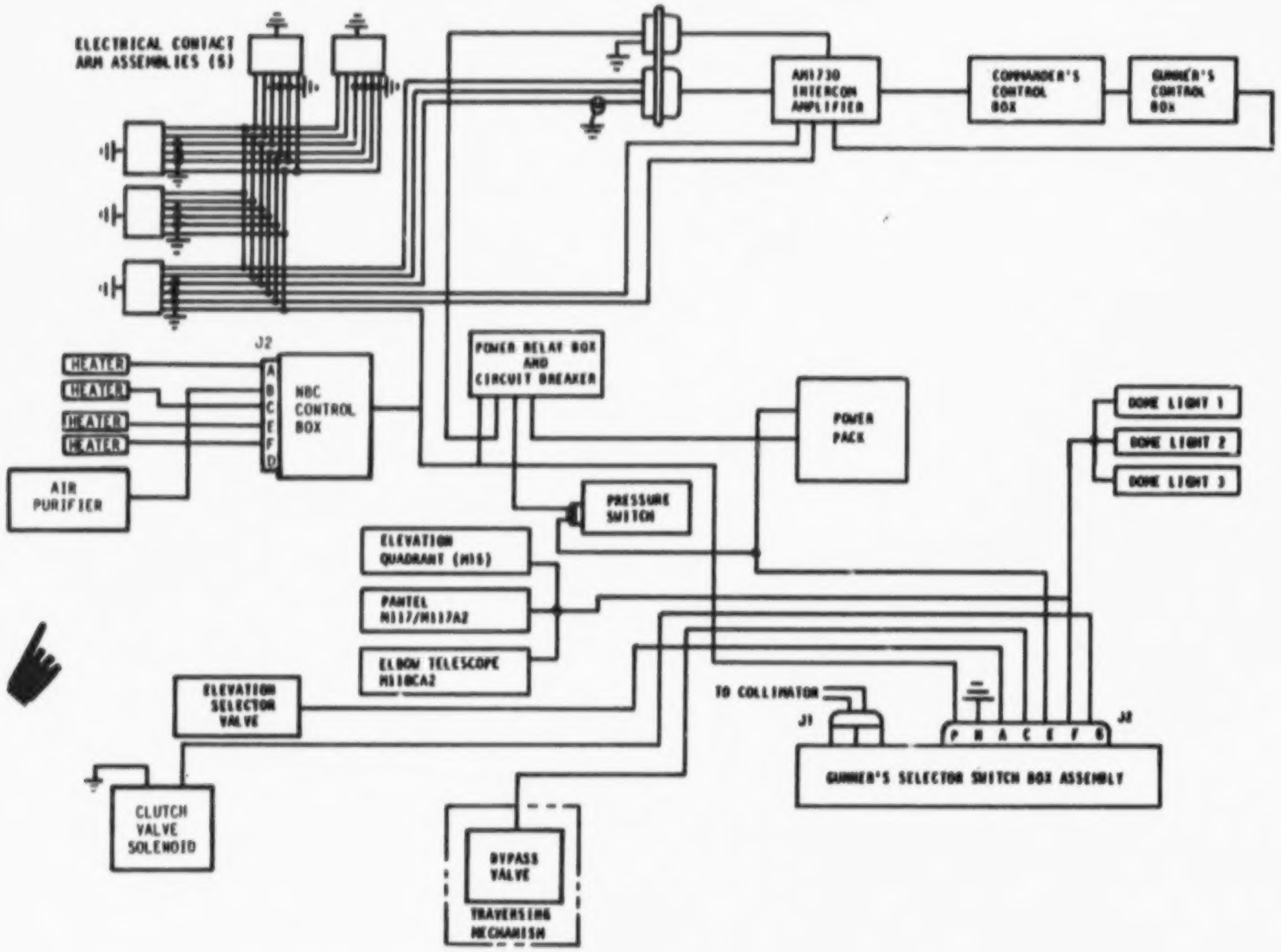
The electrical schematic for M109A2/M109A3 cabs is figure FO-1 on page FP-1. The electrical schematic for M109A4 cabs is figure FO-1.1 on page FP-1.1. The hydraulic schematic for M109A2/M109A3 cabs is figure FO-2 on page FP-2. The hydraulic schematic for M109A4 cabs is figure FO-2.1 on page FP-2.1. Standard electrical and hydraulic symbols are used in the schematics. Because there are a great number of hydraulic symbols used in the cab hydraulic schematic, these symbols have been illustrated and defined on pages D-3 and D-4.

APPENDIX D ELECTRICAL/HYDRAULIC SCHEMATICS

D-2. ELECTRICAL SCHEMATIC


ELECTRICAL CONTACT ARM ASSEMBLIES (5)
AM1730 INTERCOM AMPLIFIER
COMMANDER'S CONTROL BOX
GUNNER'S CONTROL BOX
POWER RELAY BOX AND CIRCUIT BREAKER
POWER PACK
DOME LIGHT 1
DOME LIGHT 2
DOME LIGHT 3
ELEVATION SELECTOR VALVE
PRESSURE SWITCH
ELEVATION QUADRANT (M15)
PANTEL M117/M117A2
ELBOW TELESCOPE M118CA2
TO COLLIMATOR
J1
J2
P N A C E F G
GUNNER'S SELECTOR SWITCH BOX ASSEMBLY
CLUTCH
BYPASS VALVE
TRAVERSING MECHANISM

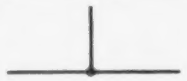
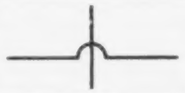
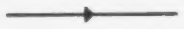
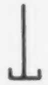
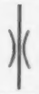
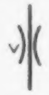
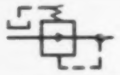
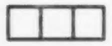
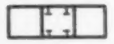
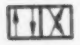
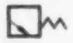
M109A2/M109A3 CAB


ELECTRICAL CONTACT ARM ASSEMBLIES (5)
AM1730 INTERCOM AMPLIFIER
COMMANDER'S CONTROL BOX
GUNNER'S CONTROL BOX
HEATER
HEATER
HEATER
HEATER
J2
A
B
C
E
F
D
NBC CONTROL BOX
AIR PURIFIER
POWER RELAY BOX AND CIRCUIT BREAKER
POWER PACK
DOME LIGHT 1
DOME LIGHT 2
DOME LIGHT 3
PRESSURE SWITCH
ELEVATION QUADRANT (M15)
PANTEL M117/M117A2
ELBOW TELESCOPE M118CA2
ELEVATION SELECTOR VALVE
TO COLLIMATOR
J1
J2
P
H
A
C
E
F
G
GUNNER'S SELECTOR SWITCH BOX ASSEMBLY
CLUTCH VALVE SOLENOID
BYPASS VALVE
TRAVERSING MECHANISM

M109A4 CAB

D-3. HYDRAULIC SYMBOLS DEFINED

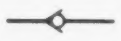
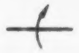
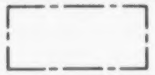
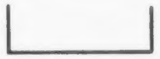
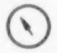
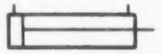
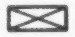
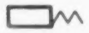
PROVIDED BELOW ARE THE HYDRAULIC SYMBOLS AS USED ON THE HYDRAULIC SCHEMATIC PROVIDED ON PAGE FO-1, FO-2.

LINES AND LINE FUNCTIONS	
LINE, WORKING	———
LINE, PILOT	— — — — —
LINE, DRAIN	- - - - - - - -
CONNECTOR	•
LINE, JOINING	
LINE, PASSING	
DIRECTION OF FLOW	
LINE TO RESERVOIR	
RESTRICTION, FIXED	
RESTRICTION, VARIABLE	
BASIC VALVE SYMBOLS	
PRESSURE REDUCING VALVE	
BASIC VALVE ENVELOPE	□
BASIC VALVE SYMBOL, MULTIPLE FLOW PATHS	
FLOW PATHS BLOCKED IN CENTER POSITION	
MULTIPLE FLOW PATHS (ARROW SHOWS FLOW DIRECTION)	
RELIEF VALVE, SPRING RETURNED	

APPENDIX D ELECTRICAL/HYDRAULIC SCHEMATICS

D-3. HYDRAULIC SYMBOLS DEFINED

PROVIDED BELOW ARE THE HYDRAULIC SYMBOLS AS USED ON THE HYDRAULIC SCHEMATIC PROVIDED ON PAGE FO-1, FO-2.

BASIC VALVE SYMBOLS-Continued	
CHECK VALVE	
MISCELLANEOUS COMPONENTS	
DIRECTION OF ROTATION (ARROW IN FRONT OF SHAFT)	
COMPONENT ENCLOSURE	
RESERVOIR, VENTED	
PRESSURE GAGE	
CYLINDER, DOUBLE ACTING	
KNOB	
MANUAL ACTUATOR, SPRING RETURNED	
SOLENOID	SOL

MISCELLANEOUS COMPONENTS-Continued	
COMPONENT PORT	△
MOTOR, HYDRAULIC, FIXED DISPLACEMENT	MF
PUMP, HYDRAULIC, FIXED DISPLACEMENT	PF
GAS (NITROGEN)-OVER- HYDRAULIC FLUID ACCUMULATOR	ACC
SWITCH, PRESSURE	PS
FILTER, HYDRAULIC FLUID	FLT
MOTOR, ELECTRIC	ELEC MOT
TRAVERSE LEFT	TL
TRAVERSE RIGHT	TR

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS

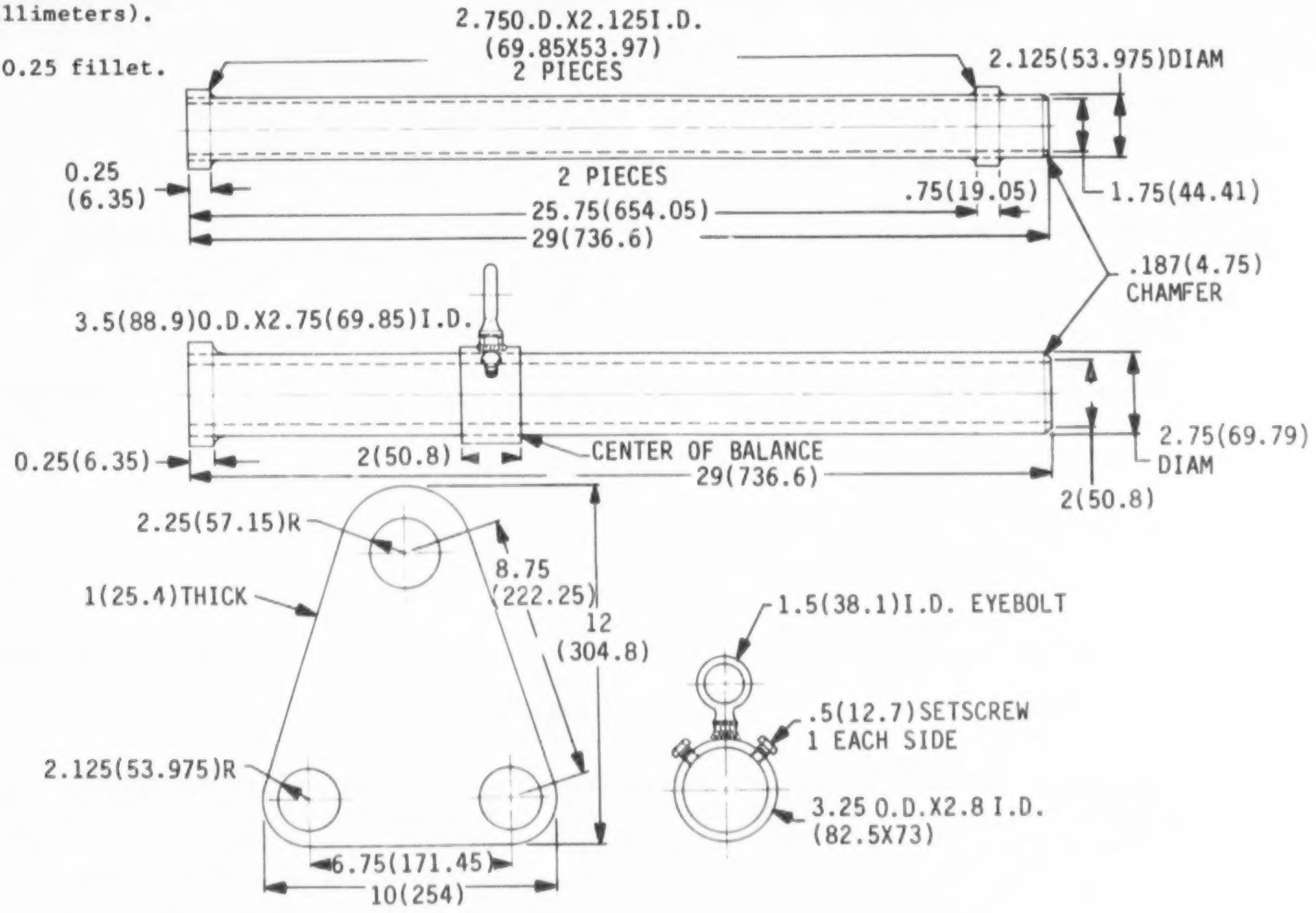
The fabricated tools listed below apply only to direct support and general support maintenance shops to enable these organizations to fabricate the tool locally if desired. These tools are of particular value to organizations engaged in repairing a number of identical components.

Item	Page Reference	Usage
Ammunition Rack Removal and Lifting Tool	E-2	To remove and lift bustle rack assembly
Arm and Plate Lifter	E-4	To remove and install breech mechanism
Cab Stand	E-5	To accommodate cab when removed from vehicle
Eyebolt Assembly	E-6	To remove and install cannon assembly
Guide Tool Assembly	E-7	To remove and install front and rear bearing assemblies in elevating cylinder
Guide Rods	E-10	To remove and install guide tool assembly
Hinge Pin Bushing Driver	E-12	To remove breech cam hinge pin
Spanner	E-13	To loosen elevating cylinder adapter
T-Handle	E-14	To depress detent in removing thrust collar and evacuator
Tray	E-15	To remove and install cannon M185, with cab installed
Tripod, Fabricated Cradle Mount	E-18	To support cannon tube
Tripod, Fabricated Cannon Tube, Hydraulic	E-19	To support cannon tube
Breech Stand	E-20	To support breech ring body

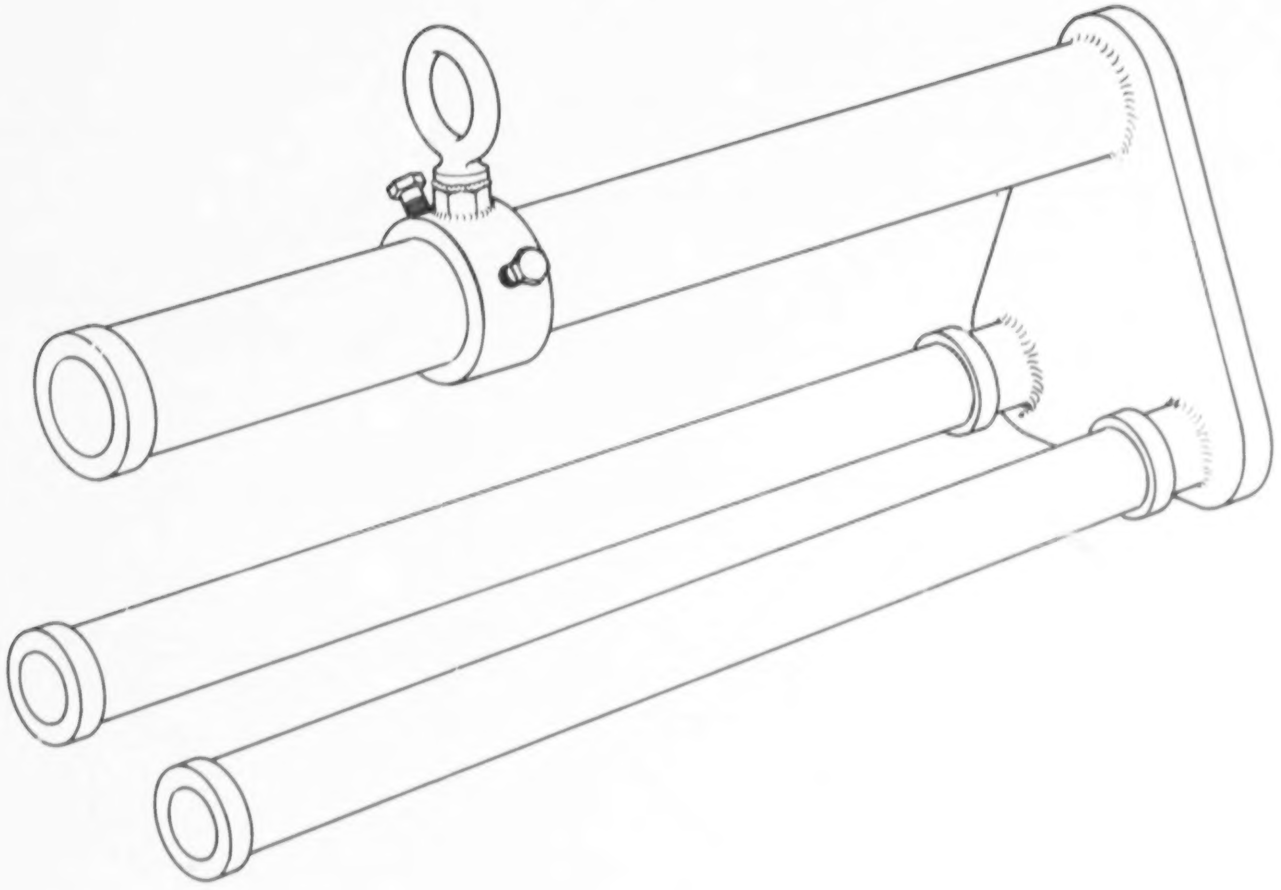
APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS

NOTE

- All dimensions shown are in inches (millimeters).
- All welds 0.25 fillet.

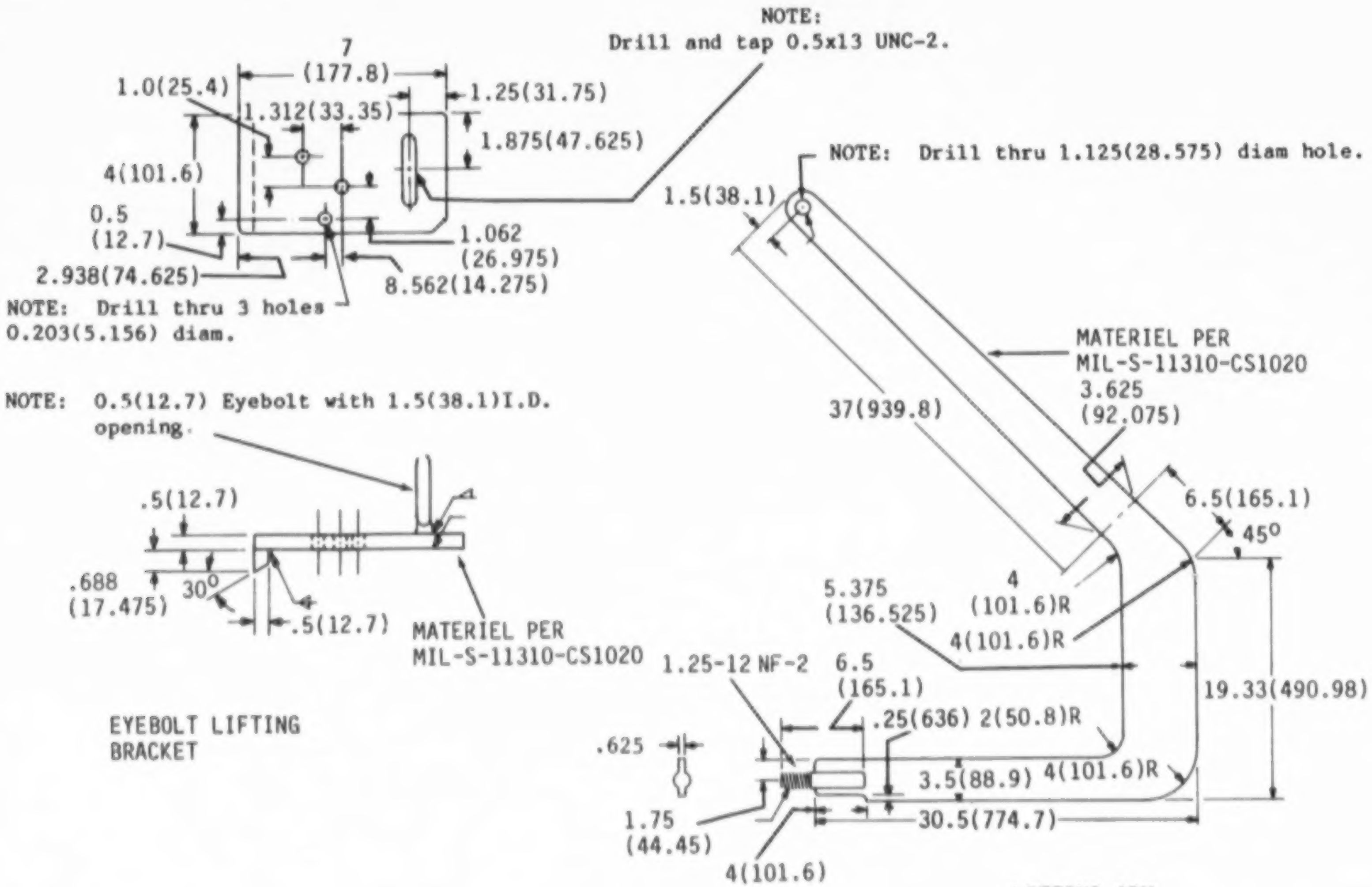

2.750.D.X2.125I.D.
(69.85X53.97)
2 PIECES
2.125(53.975)DIAM
0.25
(6.35)
2 PIECES
.75(19.05)
1.75(44.41)
25.75(654.05)
29(736.6)
.187(4.75)
CHAMFER
3.5(88.9)O.D.X2.75(69.85)I.D.
0.25(6.35)
2(50.8)
CENTER OF BALANCE
29(736.6)
2.75(69.79)
DIAM
2(50.8)
2.25(57.15)R
8.75
(222.25)
1(25.4)THICK
12
(304.8)
1.5(38.1)I.D. EYEBOLT
.5(12.7)SETSCREW
1 EACH SIDE
2.125(53.975)R
3.25 O.D.X2.8 I.D.
(82.5X73)
6.75(171.45)
10(254)

AMMUNITION RACK REMOVAL AND LIFTING TOOL



AMMUNITION RACK REMOVAL AND LIFTING TOOL

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS



NOTE: Drill and tap 0.5x13 UNC-2.

NOTE: Drill thru 3 holes 0.203(5.156) diam.

NOTE: Drill thru 1.125(28.575) diam hole.

NOTE: 0.5(12.7) Eyebolt with 1.5(38.1)I.D. opening.

7
(177.8)
1.0(25.4)
1.312(33.35)
1.25(31.75)
1.875(47.625)
4(101.6)
0.5
(12.7)
2.938(74.625)
1.062
(26.975)
8.562(14.275)
.5(12.7)
.688
(17.475)
30°
.5(12.7)
MATERIEL PER
MIL-S-11310-CS1020
1.5(38.1)
37(939.8)
MATERIEL PER
MIL-S-11310-CS1020
3.625
(92.075)
6.5(165.1)
45°
5.375
(136.525)
4
(101.6)R
4(101.6)R
19.33(490.98)
1.25-12 NF-2
6.5
(165.1)
.25(636)
2(50.8)R
.625
3.5(88.9)
4(101.6)R
1.75
(44.45)
30.5(774.7)
4(101.6)

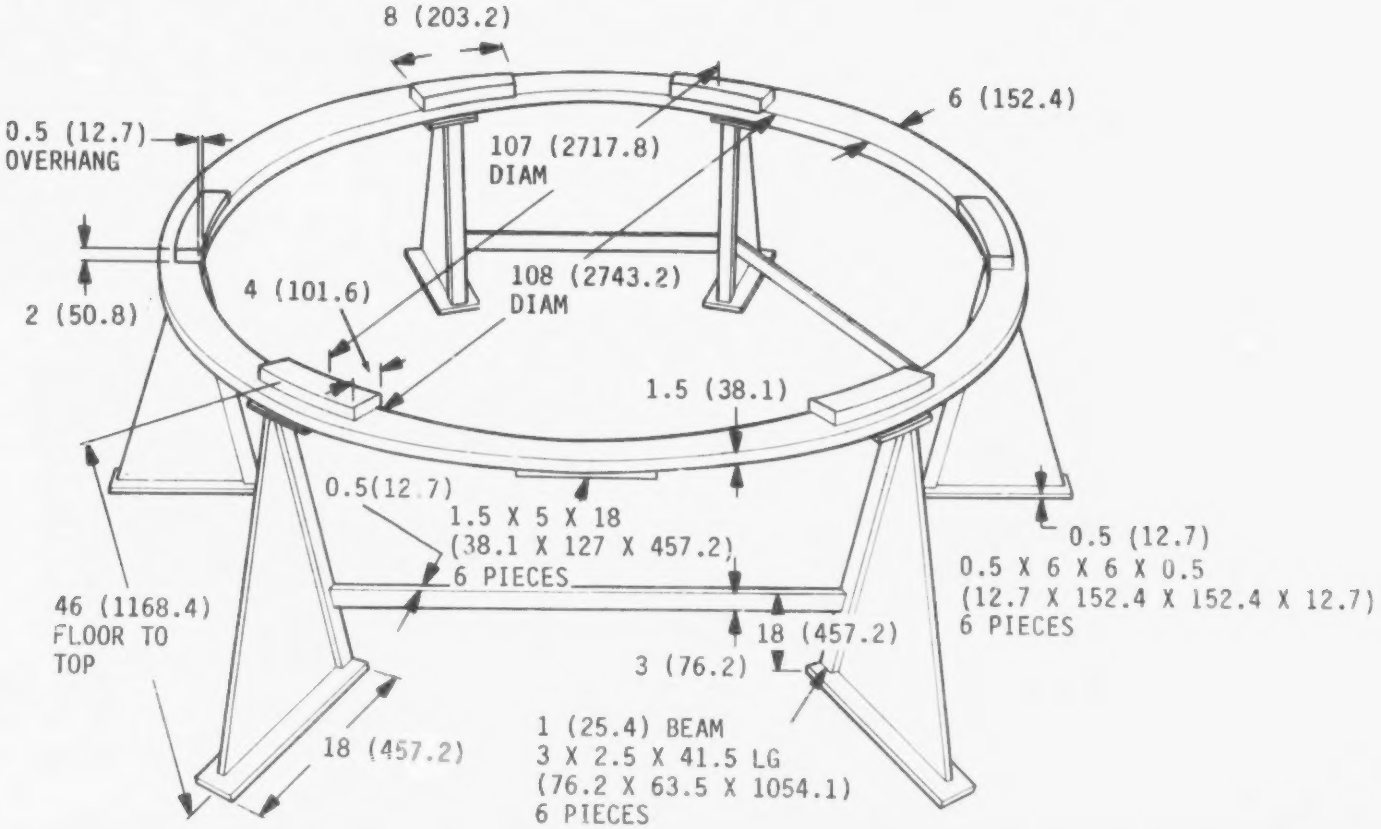
EYEBOLT LIFTING BRACKET

LIFTING ARM

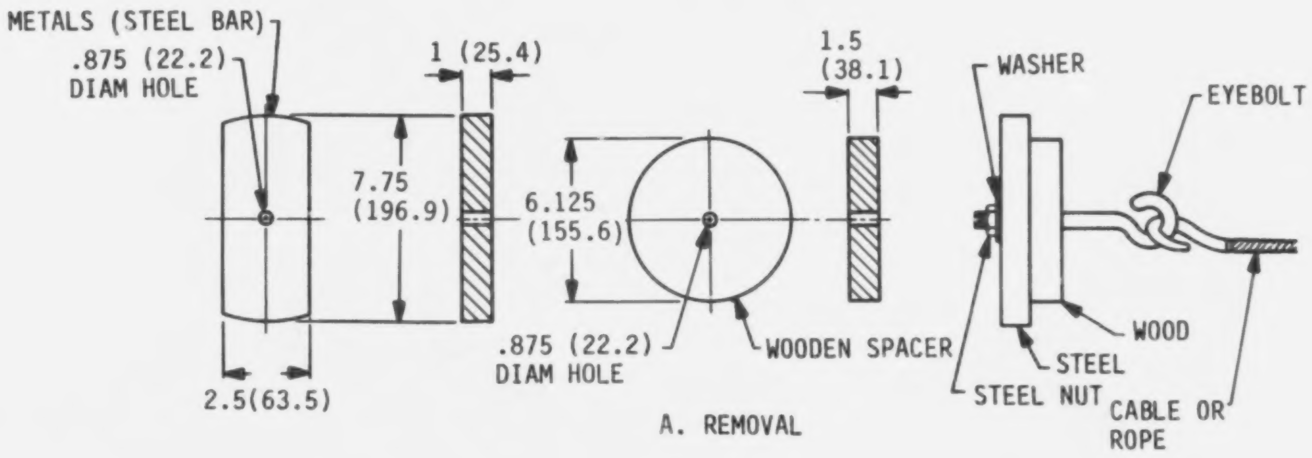
BREECH MECHANISM AND LIFTING EYE BRACKET

NOTE

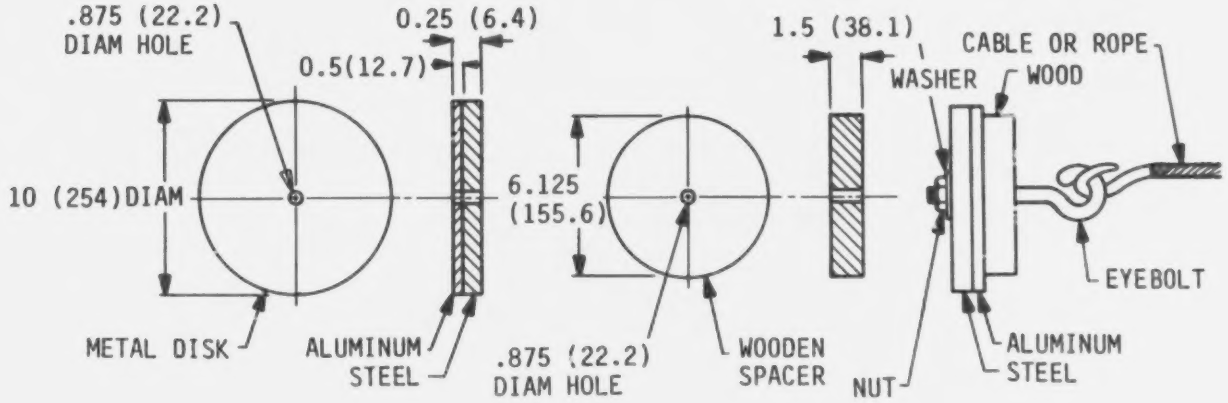
- All dimensions shown are in inches (millimeters).
- All joints to have 0.25 fillet welds.


8 (203.2)
0.5 (12.7)
OVERHANG
107 (2717.8)
DIAM
6 (152.4)
2 (50.8)
4 (101.6)
108 (2743.2)
DIAM
1.5 (38.1)
0.5(12.7)
1.5 X 5 X 18
(38.1 X 127 X 457.2)
6 PIECES
0.5 (12.7)
0.5 X 6 X 6 X 0.5
(12.7 X 152.4 X 152.4 X 12.7)
6 PIECES
46 (1168.4)
FLOOR TO
TOP
18 (457.2)
3 (76.2)
18 (457.2)
1 (25.4) BEAM
3 X 2.5 X 41.5 LG
(76.2 X 63.5 X 1054.1)
6 PIECES

CAB STAND


METALS (STEEL BAR)
.875 (22.2) DIAM HOLE
1 (25.4)
7.75 (196.9)
2.5(63.5)
6.125 (155.6)
.875 (22.2) DIAM HOLE
WOODEN SPACER
1.5 (38.1)
WASHER
EYEBOLT
WOOD
STEEL
STEEL NUT
CABLE OR ROPE

A. REMOVAL


.875 (22.2) DIAM HOLE
0.25 (6.4)
0.5(12.7)
10 (254)DIAM
METAL DISK
ALUMINUM
STEEL
6.125 (155.6)
.875 (22.2) DIAM HOLE
WOODEN SPACER
1.5 (38.1)
WASHER
CABLE OR ROPE
WOOD
EYEBOLT
NUT
ALUMINUM
STEEL

B. INSTALLATION

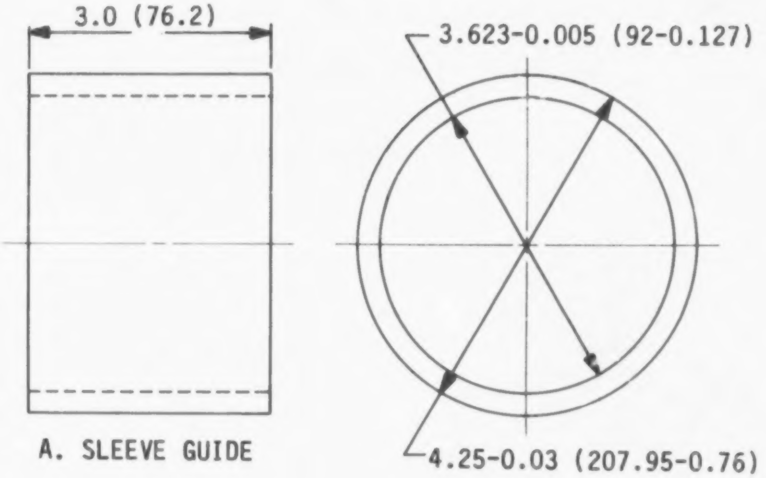
NOTE

All dimensions shown are in inches (millimeters).

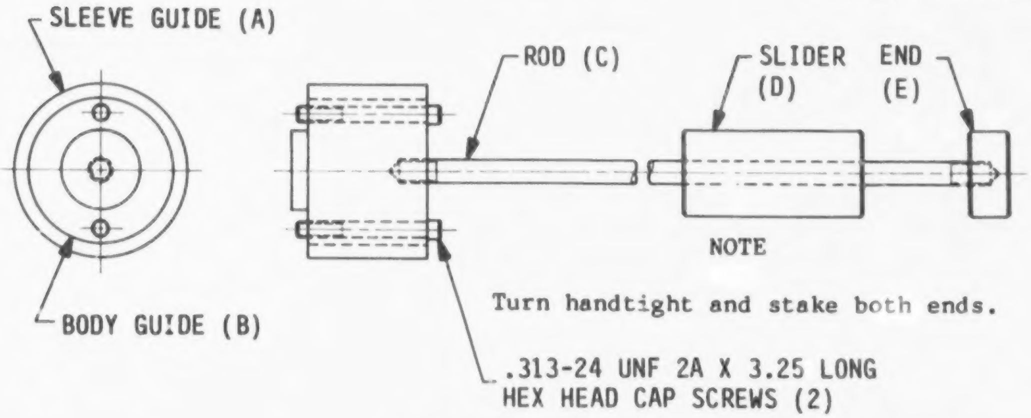
EYEBOLT ASSEMBLY

NOTE

- All dimensions shown are in inches (millimeters).
- Materiel: teflon, nylon or other suitable materiel.
- Remove all sharp edges and corners.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27).
- Finish 250 all over.


3.0 (76.2)
3.623-0.005 (92-0.127)
4.25-0.03 (207.95-0.76)

A. SLEEVE GUIDE


SLEEVE GUIDE (A)
BODY GUIDE (B)
ROD (C)
SLIDER (D)
END (E)
.313-24 UNF 2A X 3.25 LONG HEX HEAD CAP SCREWS (2)

NOTE

Turn handtight and stake both ends.

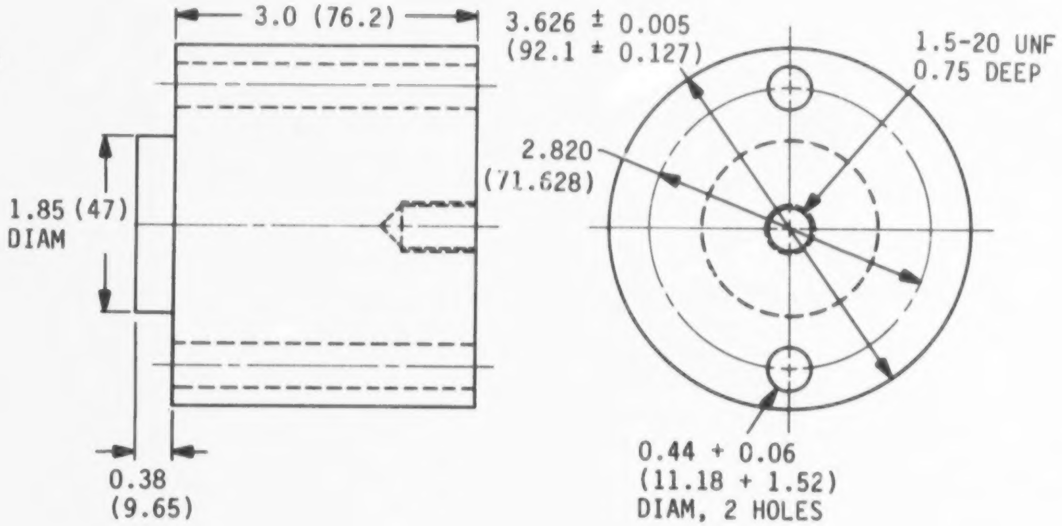
ASSEMBLED VIEW

GUIDE TOOL ASSEMBLY

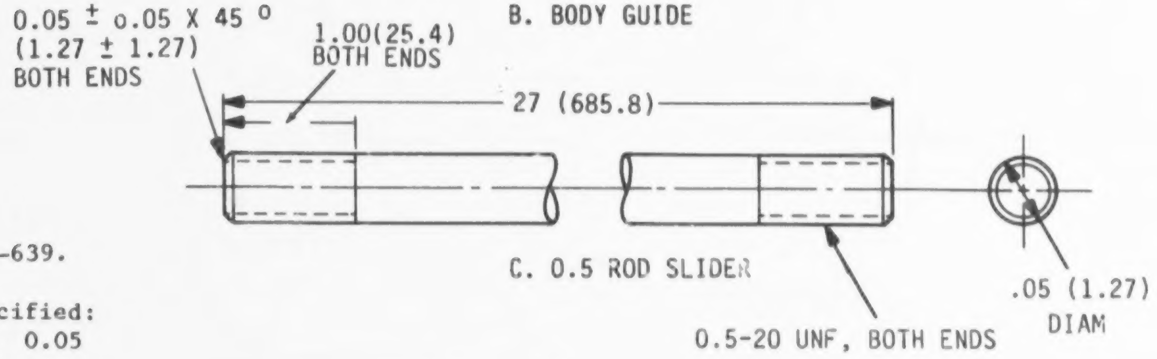
APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS

NOTE

- All dimensions shown are in inches (millimeters).
- Materiel: AL,QQ-A-200 or QQ-Q-250; tool steel, QQ-S-624, QQ-S-631 or QQ-S-634.
- Remove all sharp edges and corners.
- Unless otherwise specified: three-place decimals ± 0.05 (0.127). Two-place decimals ± 0.01 (0.25).


3.0 (76.2)
3.626 ± 0.005
(92.1 ± 0.127)
1.5-20 UNF
0.75 DEEP
2.820
(71.628)
1.85 (47)
DIAM
0.38
(9.65)
0.44 + 0.06
(11.18 + 1.52)
DIAM, 2 HOLES

B. BODY GUIDE


0.05 ± 0.05 X 45 °
(1.27 ± 1.27)
BOTH ENDS
1.00(25.4)
BOTH ENDS
27 (685.8)
0.5-20 UNF, BOTH ENDS
.05 (1.27)
DIAM

C. 0.5 ROD SLIDER

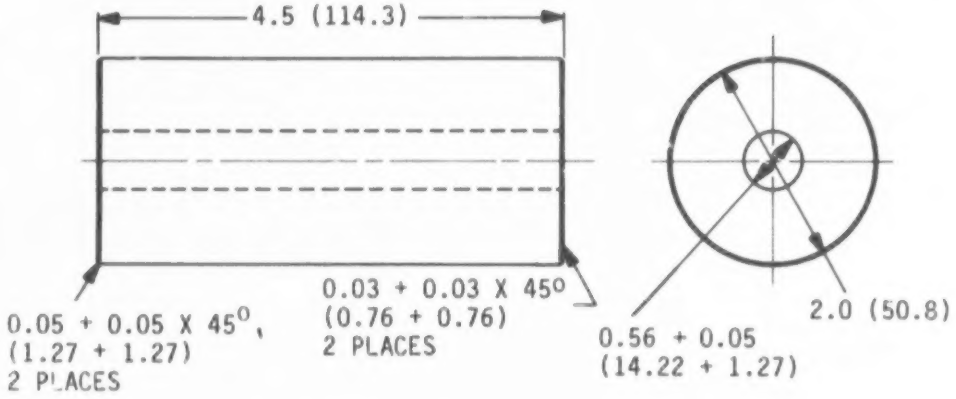
NOTE

- Materiel: Brass, QQ-B-639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27). Angles ± 5°.

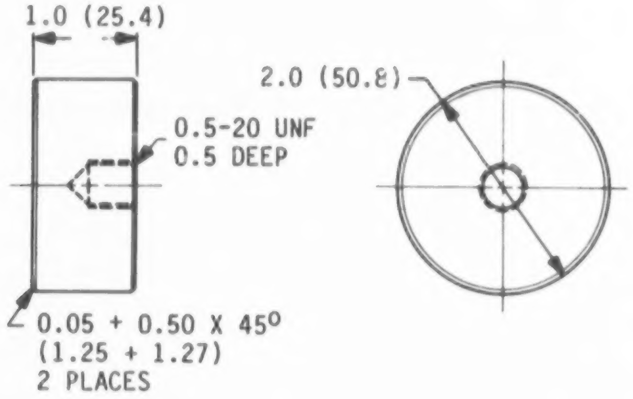
GUIDE TOOL ASSEMBLY

NOTE

- All dimensions shown are in inches (millimeters).
- Materiel: tool steel, QQ-S-631, QQ-S-634 or QQ-S-624.


4.5 (114.3)
0.05 + 0.05 X 45°,
(1.27 + 1.27)
2 PLACES
0.03 + 0.03 X 45°
(0.76 + 0.76)
2 PLACES
0.56 + 0.05
(14.22 + 1.27)
2.0 (50.8)

D. SLIDER


1.0 (25.4)
2.0 (50.8)
0.5-20 UNF
0.5 DEEP
0.05 + 0.50 X 45°
(1.25 + 1.27)
2 PLACES

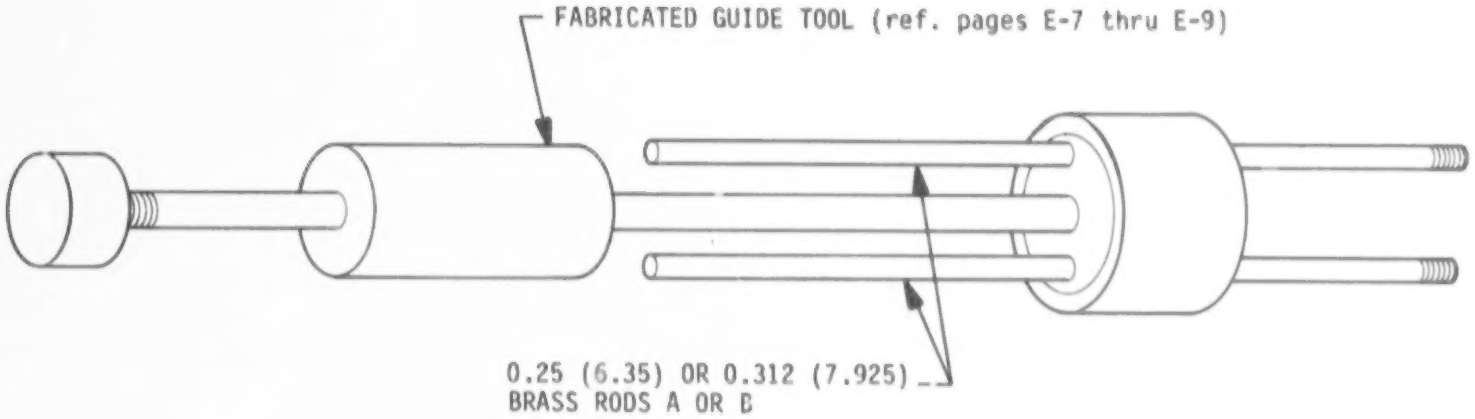
E.END

NOTE

- Materiel: tool steel, QQ-S-631, QQ-S-634 or QQ-S-624; brass, QQ-B-639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27). Angles ± 5°.

GUIDE TOOL ASSEMBLY

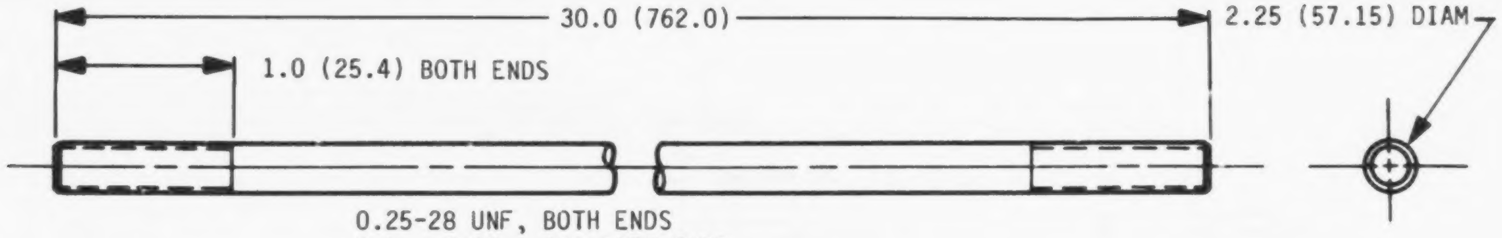
APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS


FABRICATED GUIDE TOOL (ref. pages E-7 thru E-9)
0.25 (6.35) OR 0.312 (7.925)
BRASS RODS A OR B

GUIDE RODS

NOTE

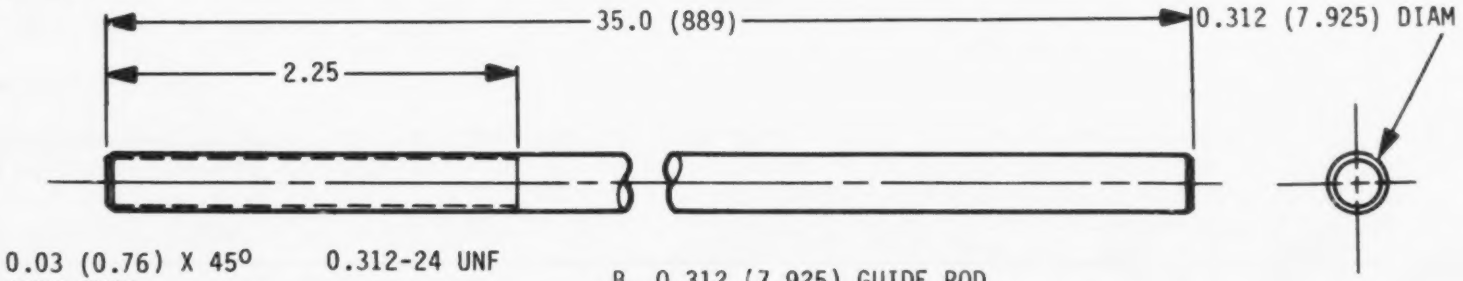
- All dimensions shown are in inches (millimeters).
- Materiel: brass, QQ-B-639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27). Angles ± 5°.
- Finish 250 all over.


30.0 (762.0)
2.25 (57.15) DIAM
1.0 (25.4) BOTH ENDS
0.25-28 UNF, BOTH ENDS
0.3 + 0.03 x 45° BOTH ENDS
7.6 + 0.76

A. 0.25 (6.35) GUIDE ROD
2 REQUIRED

NOTE

- Materiel: brass, QQ-B-639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27).


35.0 (889)
0.312 (7.925) DIAM
2.25
0.03 (0.76) X 45°
BOTH ENDS
0.312-24 UNF

B. 0.312 (7.925) GUIDE ROD
2 REQUIRED

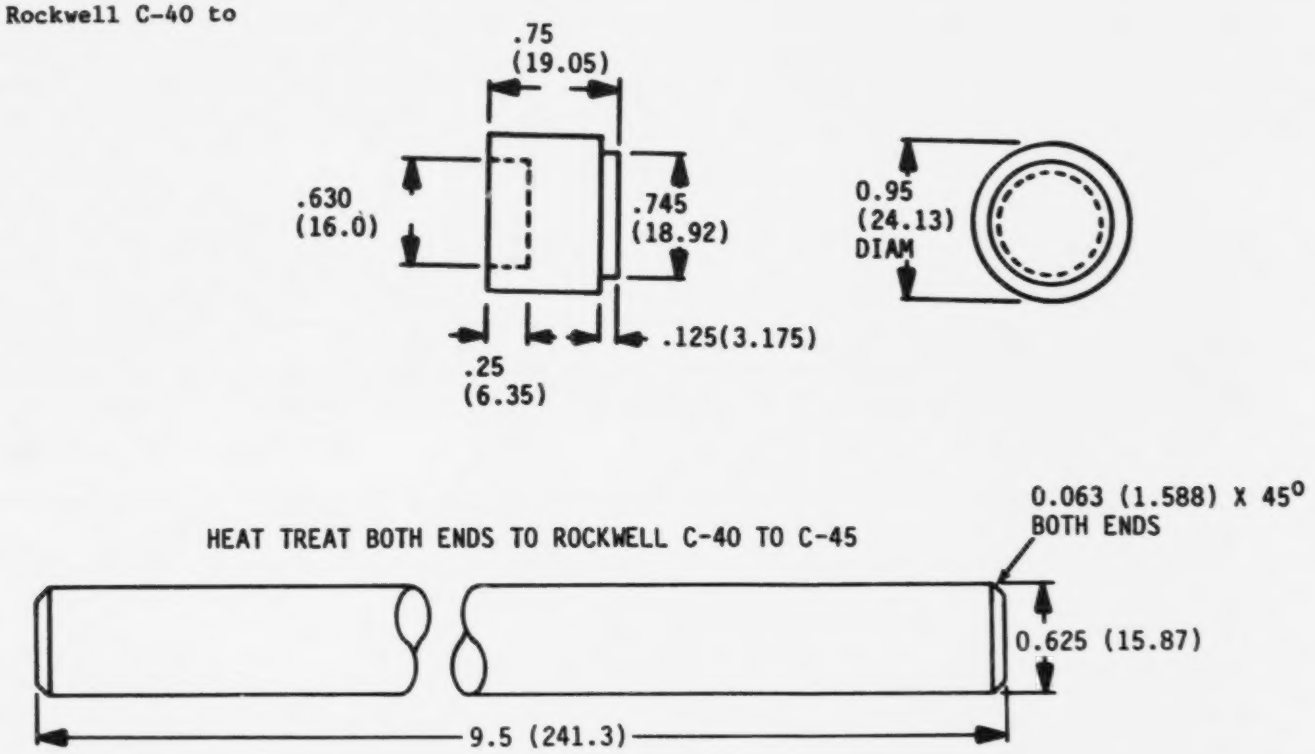
GUIDE RODS

best copy available

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS

NOTE

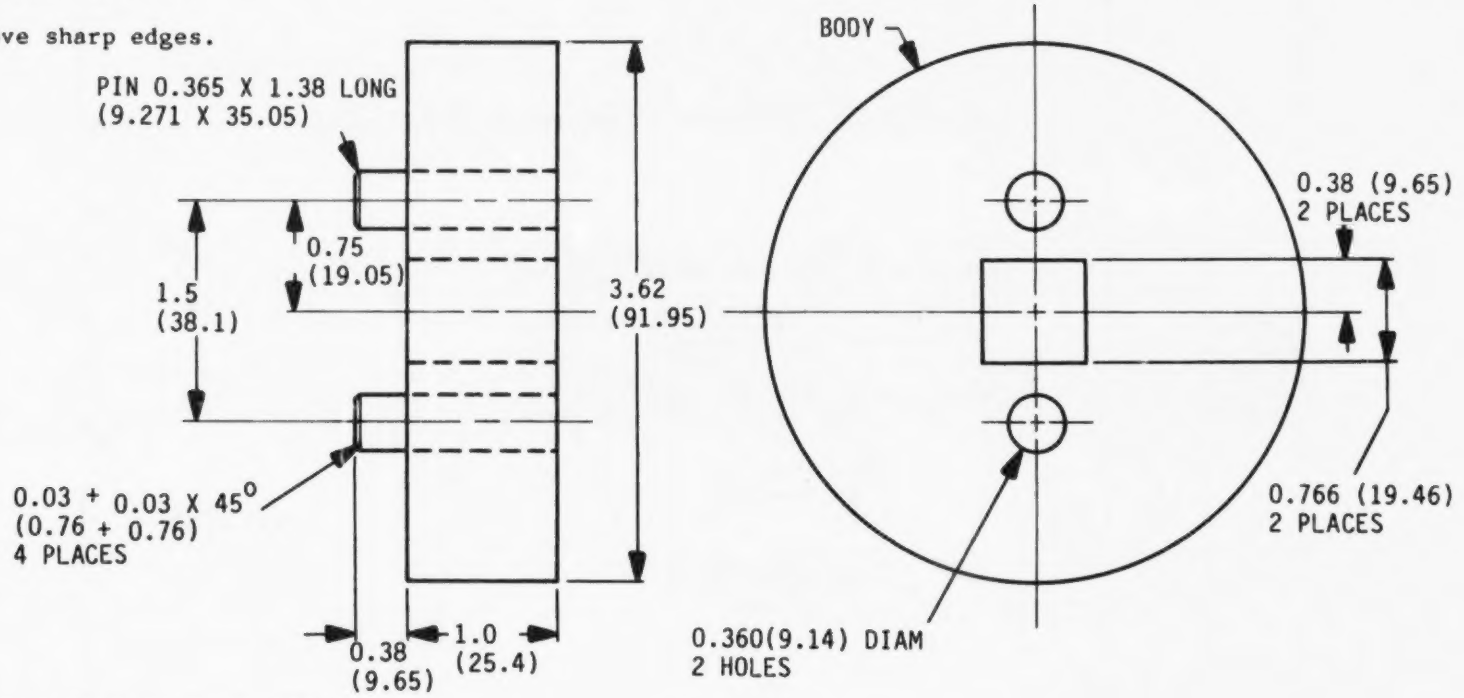
- All dimensions shown are in inches (millimeters).
- Materiel: 4140.
- Heat treat to Rockwell C-40 to C-45.


.75
(19.05)
.630
(16.0)
.745
(18.92)
.25
(6.35)
.125(3.175)
0.95
(24.13)
DIAM
HEAT TREAT BOTH ENDS TO ROCKWELL C-40 TO C-45
0.063 (1.588) X 45°
BOTH ENDS
0.625 (15.87)
9.5 (241.3)

HINGE PIN BUSHING DRIVER

NOTE

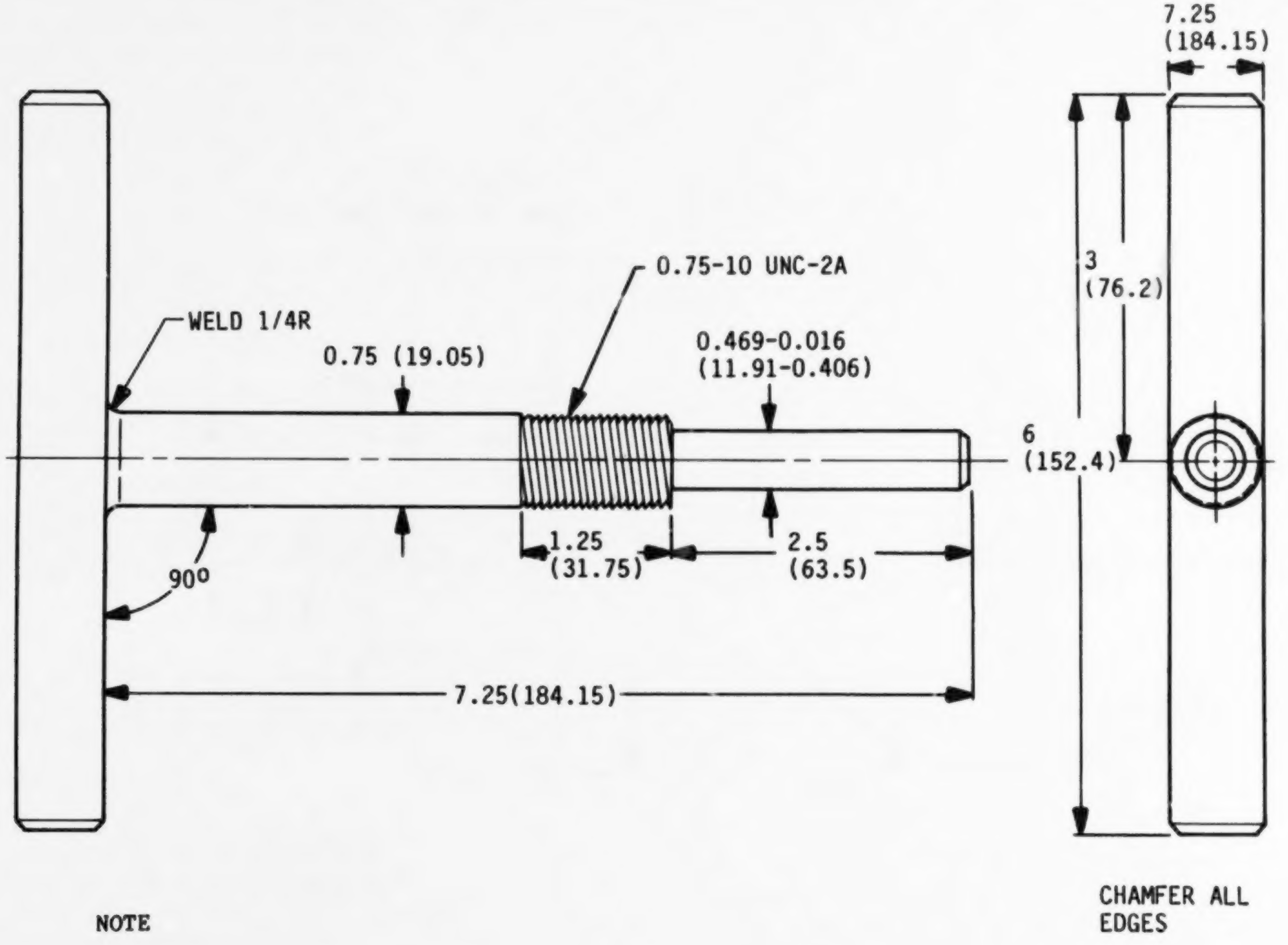
- All dimensions shown are in inches (millimeters).
- Materiel: tool steel, medium to high carbon, QQ-S-634 or QQ-S-631 suitable.
- Remove sharp edges.


PIN 0.365 X 1.38 LONG
(9.271 X 35.05)
0.75
(19.05)
1.5
(38.1)
3.62
(91.95)
0.03 + 0.03 X 45°
(0.76 + 0.76)
4 PLACES
0.38
(9.65)
1.0
(25.4)
BODY
0.38 (9.65)
2 PLACES
0.766 (19.46)
2 PLACES
0.360(9.14) DIAM
2 HOLES

- Control hole diam to attain press fit with pins.
- Unless otherwise specified: three-place decimals ± 0.05 (0.127). Two-place decimals ± 0.02 (0.51). Angles ± 5°.
- Finish 250 all over.

SPANNER

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS


7.25
(184.15)
3
(76.2)
6
(152.4)
0.75-10 UNC-2A
WELD 1/4R
0.75 (19.05)
0.469-0.016
(11.91-0.406)
90°
1.25
(31.75)
2.5
(63.5)
7.25(184.15)
CHAMFER ALL
EDGES

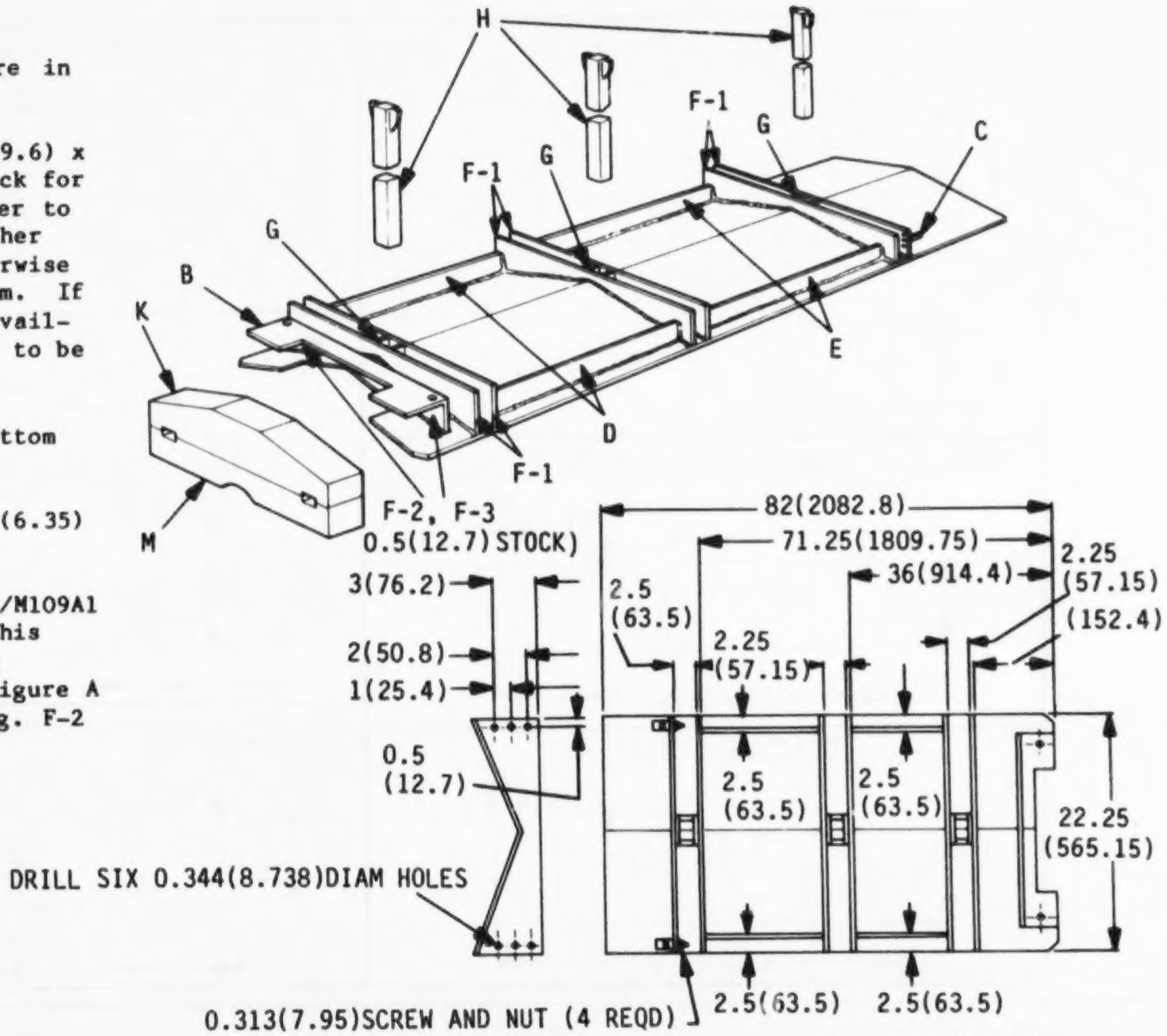
NOTE

Materiel: 0.75 inch 1020 cold rolled steel, case hardened.

T-HANDLE

NOTE

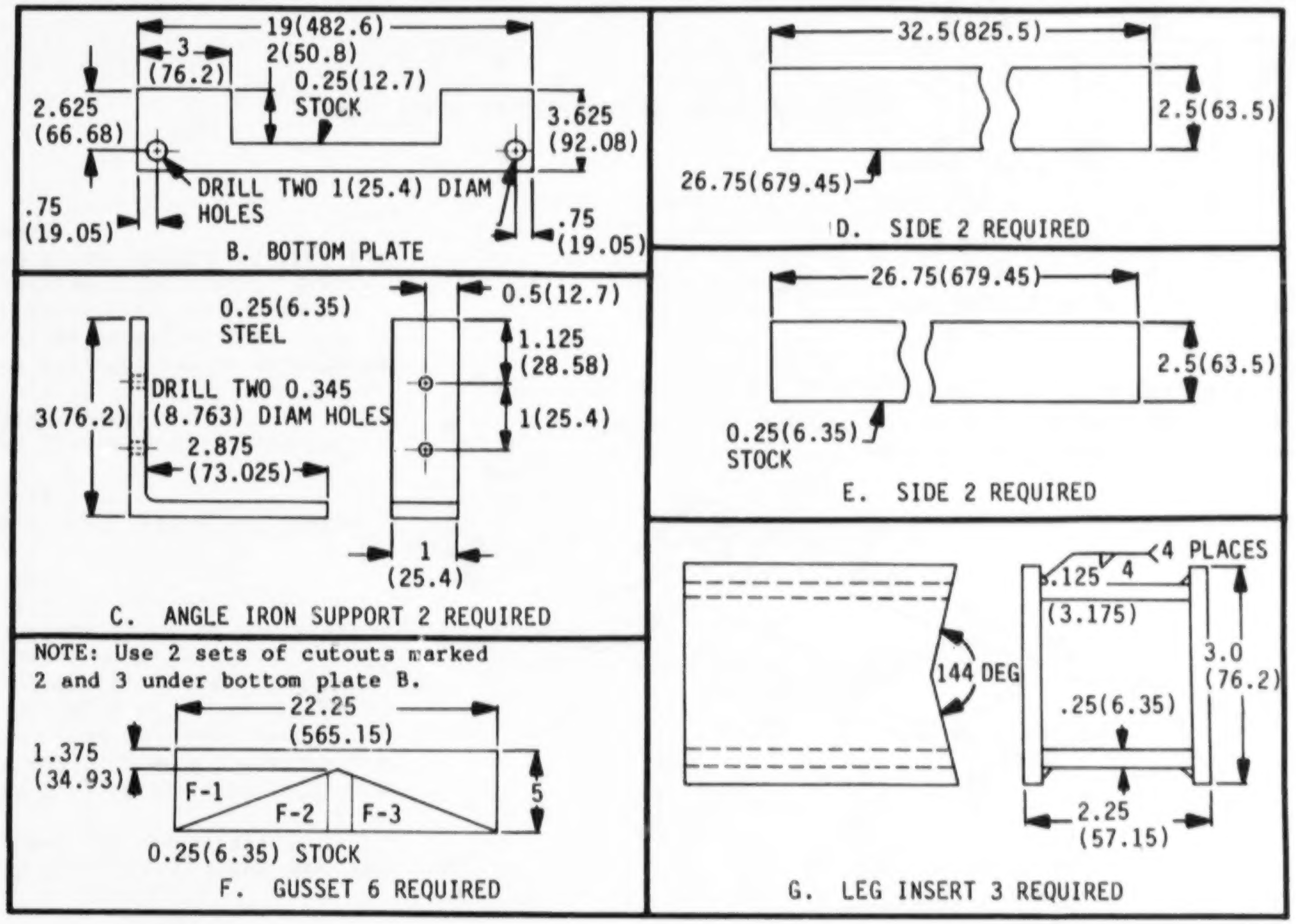
- All dimensions shown are in inches (millimeters).
- Use 0.25 (6.35) x 24 (609.6) x 88 (2235.2) aluminum stock for tray base and bend center to 144 degrees. All other components, unless otherwise noted, are to be aluminum. If aluminum stock is not available, all components are to be steel.
- Weld both sides of bottom plate.
- All joints to have 0.25 (6.35) fillet welds.
- The tray for use in M109/M109A1 may be modified to this configuration by using dimensions for tray in Figure A and B and gussets in Fig. F-2 and F-3.


H
F-1
G
C
F-1
G
G
B
K
E
D
F-1
M
F-2, F-3
0.5(12.7)STOCK)
3(76.2)
2(50.8)
1(25.4)
0.5
(12.7)
DRILL SIX 0.344(8.738)DIAM HOLES
82(2082.8)
71.25(1809.75)
36(914.4)
2.25
(57.15)
(152.4)
2.5
(63.5)
2.25
(57.15)
2.5
(63.5)
2.5
(63.5)
22.25
(565.15)
0.313(7.95)SCREW AND NUT (4 REQD)
2.5(63.5)
2.5(63.5)

A. TRAY (ASSEMBLED VIEW)

TRAY

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS


19(482.6)
3
(76.2)
2(50.8)
0.25(12.7)
STOCK
2.625
(66.68)
3.625
(92.08)
DRILL TWO 1(25.4) DIAM
HOLES
.75
(19.05)
.75
(19.05)
32.5(825.5)
2.5(63.5)
26.75(679.45)
0.25(6.35)
STEEL
0.5(12.7)
1.125
(28.58)
DRILL TWO 0.345
(8.763) DIAM HOLES
3(76.2)
1(25.4)
2.875
(73.025)
1
(25.4)
26.75(679.45)
2.5(63.5)
0.25(6.35)
STOCK
22.25
(565.15)
1.375
(34.93)
F-1
F-2
F-3
5
0.25(6.35) STOCK
4 PLACES
.125
4
(3.175)
144 DEG
3.0
(76.2)
.25(6.35)
2.25
(57.15)

B. BOTTOM PLATE

D. SIDE 2 REQUIRED

C. ANGLE IRON SUPPORT 2 REQUIRED

E. SIDE 2 REQUIRED

NOTE: Use 2 sets of cutouts marked 2 and 3 under bottom plate B.

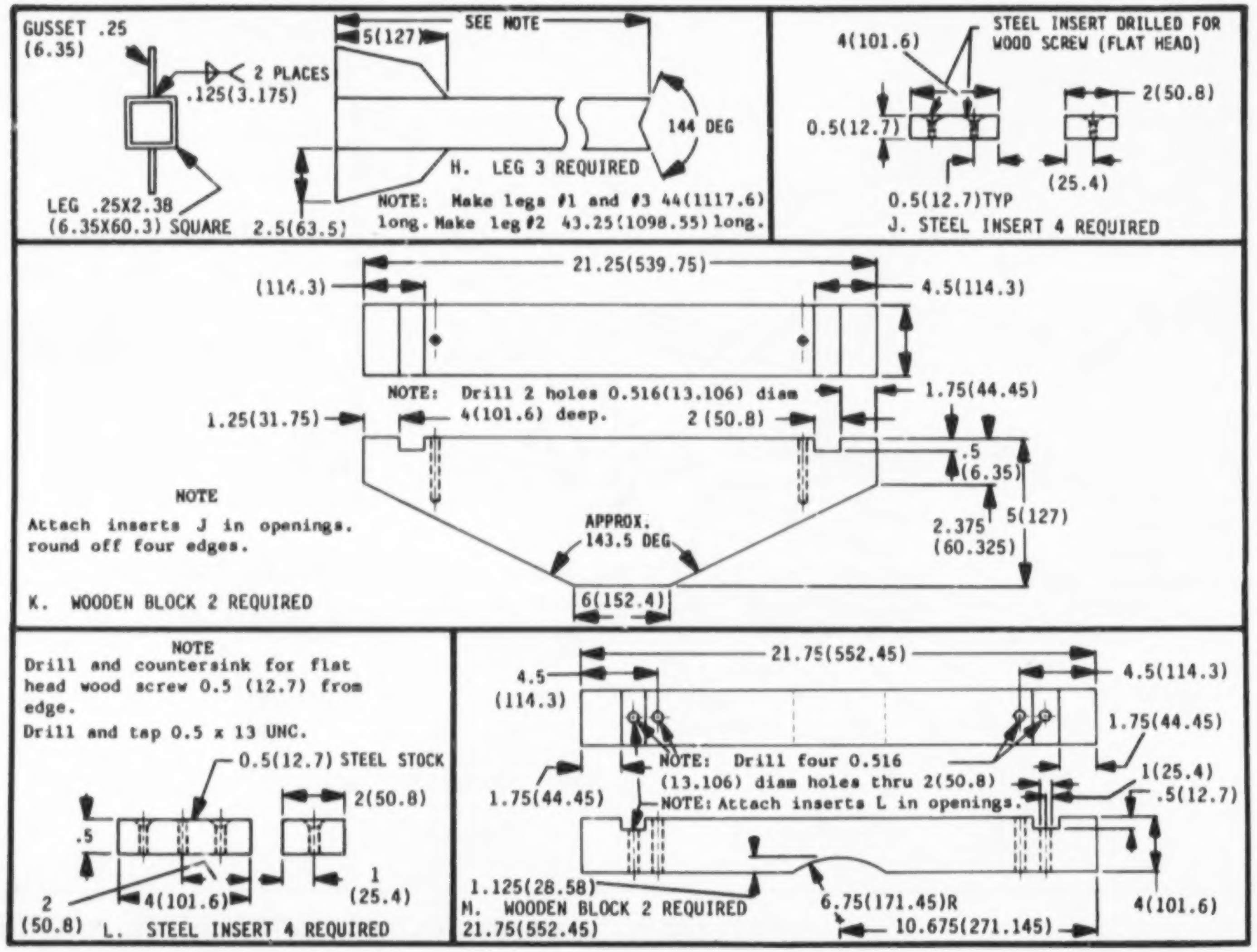
F. GUSSET 6 REQUIRED

G. LEG INSERT 3 REQUIRED

NOTE

All dimensions shown are in inches (millimeters).

TRAY


GUSSET .25
(6.35)
2 PLACES
.125(3.175)
LEG .25X2.38
(6.35X60.3) SQUARE
2.5(63.5)
SEE NOTE
5(127)
144 DEG
4(101.6)
STEEL INSERT DRILLED FOR WOOD SCREW (FLAT HEAD)
2(50.8)
0.5(12.7)
(25.4)
0.5(12.7)TYP
(114.3)
21.25(539.75)
4.5(114.3)
1.75(44.45)
1.25(31.75)
2 (50.8)
.5
(6.35)
2.375
(60.325)
5(127)
APPROX.
143.5 DEG
6(152.4)
0.5(12.7) STEEL STOCK
2(50.8)
.5
1
(25.4)
4(101.6)
2
(50.8)
21.75(552.45)
4.5
(114.3)
4.5(114.3)
1.75(44.45)
1.75(44.45)
1(25.4)
.5(12.7)
1.125(28.58)
6.75(171.45)R
10.675(271.145)
4(101.6)
21.75(552.45)

H. LEG 3 REQUIRED

NOTE: Make legs #1 and #3 44(1117.6) long. Make leg #2 43.25(1098.55) long.

J. STEEL INSERT 4 REQUIRED

NOTE: Drill 2 holes 0.516(13.106) diam 4(101.6) deep.

NOTE

Attach inserts J in openings. round off four edges.

K. WOODEN BLOCK 2 REQUIRED

NOTE

Drill and countersink for flat head wood screw 0.5 (12.7) from edge.

Drill and tap 0.5 x 13 UNC.

L. STEEL INSERT 4 REQUIRED

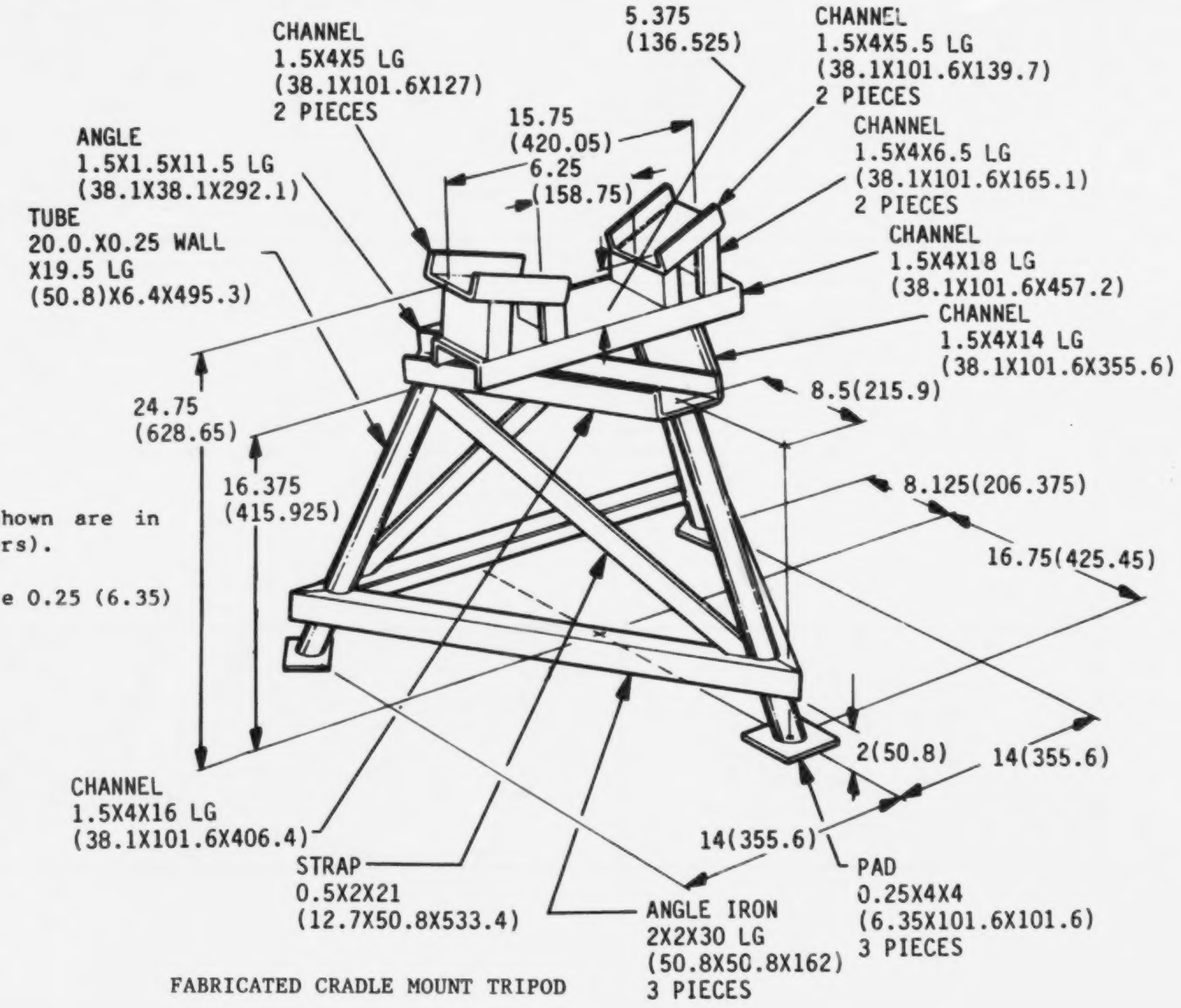
NOTE: Drill four 0.516 (13.106) diam holes thru 2(50.8)

NOTE: Attach inserts L in openings.

M. WOODEN BLOCK 2 REQUIRED

TRAY

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS


CHANNEL
1.5X4X5 LG
(38.1X101.6X127)
2 PIECES
5.375
(136.525)
CHANNEL
1.5X4X5.5 LG
(38.1X101.6X139.7)
2 PIECES
15.75
(420.05)
6.25
(158.75)
ANGLE
1.5X1.5X11.5 LG
(38.1X38.1X292.1)
CHANNEL
1.5X4X6.5 LG
(38.1X101.6X165.1)
2 PIECES
TUBE
20.0.X0.25 WALL
X19.5 LG
(50.8)X6.4X495.3)
CHANNEL
1.5X4X18 LG
(38.1X101.6X457.2)
CHANNEL
1.5X4X14 LG
(38.1X101.6X355.6)
8.5(215.9)
24.75
(628.65)
16.375
(415.925)
8.125(206.375)
16.75(425.45)
2(50.8)
14(355.6)
CHANNEL
1.5X4X16 LG
(38.1X101.6X406.4)
14(355.6)
STRAP
0.5X2X21
(12.7X50.8X533.4)
ANGLE IRON
2X2X30 LG
(50.8X50.8X162)
3 PIECES
PAD
0.25X4X4
(6.35X101.6X101.6)
3 PIECES

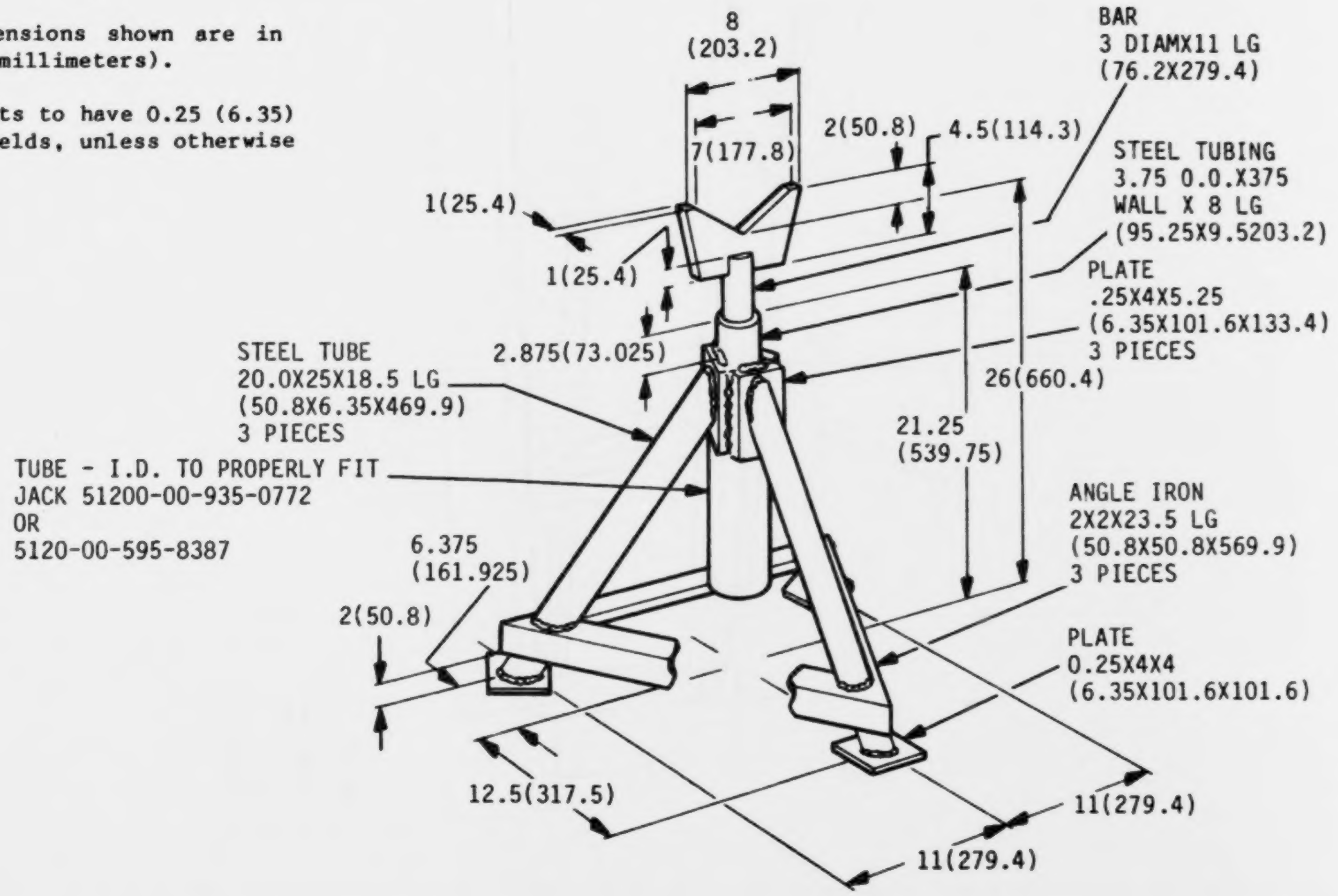
NOTE

- All dimensions shown are in inches (millimeters).
- All joints to have 0.25 (6.35) fillet welds.

FABRICATED CRADLE MOUNT TRIPOD

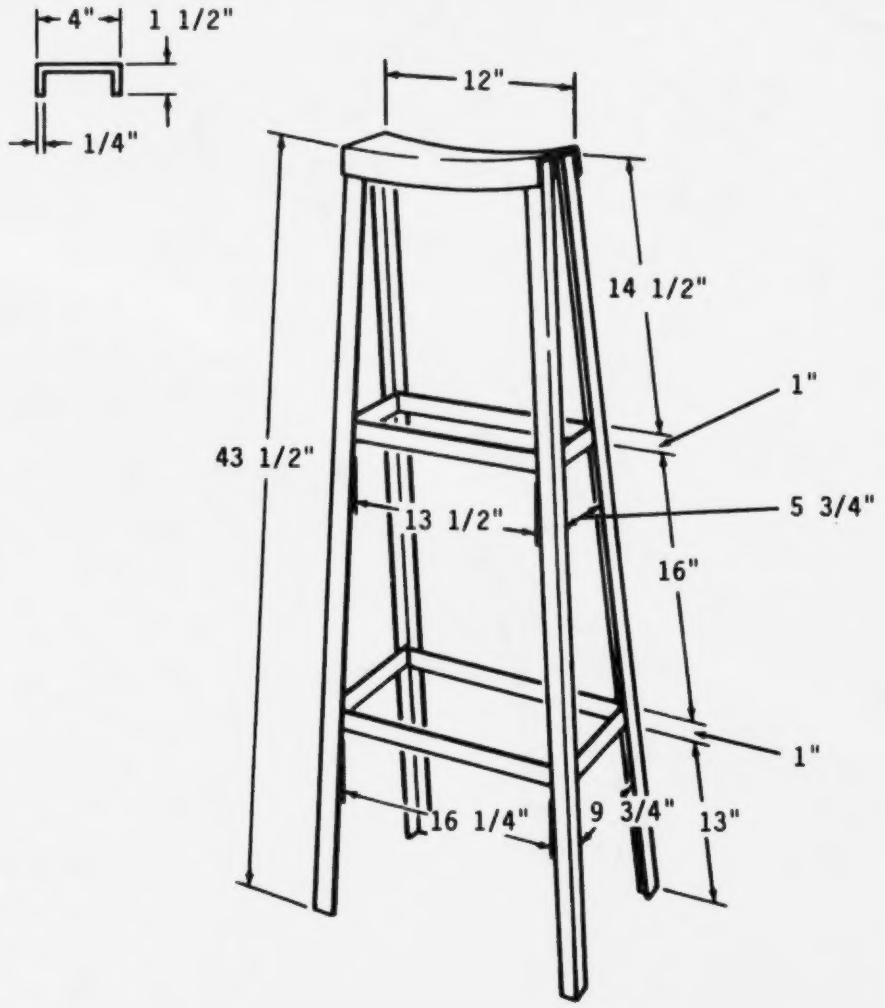
NOTE

- All dimensions shown are in inches (millimeters).
- All joints to have 0.25 (6.35) fillet welds, unless otherwise shown.


8
(203.2)
7(177.8)
2(50.8)
4.5(114.3)
BAR
3 DIAMX11 LG
(76.2X279.4)
STEEL TUBING
3.75 0.0.X375
WALL X 8 LG
(95.25X9.5203.2)
PLATE
.25X4X5.25
(6.35X101.6X133.4)
3 PIECES
1(25.4)
1(25.4)
2.875(73.025)
STEEL TUBE
20.0X25X18.5 LG
(50.8X6.35X469.9)
3 PIECES
26(660.4)
21.25
(539.75)
TUBE - I.D. TO PROPERLY FIT
JACK 51200-00-935-0772
OR
5120-00-595-8387
ANGLE IRON
2X2X23.5 LG
(50.8X50.8X569.9)
3 PIECES
6.375
(161.925)
2(50.8)
PLATE
0.25X4X4
(6.35X101.6X101.6)
12.5(317.5)
11(279.4)
11(279.4)

FABRICATED CANNON TUBE HYDRAULIC TRIPOD

APPENDIX E ILLUSTRATED LIST OF MANUFACTURED ITEMS


4"
1 1/2"
1/4"
12"
14 1/2"
1"
43 1/2"
13 1/2"
5 3/4"
16"
1"
16 1/4"
9 3/4"
13"

BREECH STAND

ALPHABETICAL INDEX

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  Inspection 5-59
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DEPARTMENT OF THE ARMY
Washington D.C., 21 April 1989

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR CAB, ARMAMENT, SIGHTING AND FIRE CONTROL, ELEVATING AND TRAVERSING SYSTEMS AND ASSOCIATED COMPONENTS

HOWITZER, MEDIUM, SELF-PROPELLED
155MM, M109A2 (2350-01-031-0586)
155MM, M109A3 (2350-01-031-8851)
155MM, M109A4 (2350-01-277-5770)

TM 9-2350-311-34-2, 14 November 1986, is changed as follows:

1. The purpose of this change is to incorporate modifications applied by MWO 9-2350-311-50-8, MWO 9-2350-311-50-9, MWO 9-1290-322-50-2, MWO 9-1240-401-50-1, MWO 9-1240-401-50-2, MWO 9-1240-401-50-3, and selected DA Forms 2028 and ERR's to update selected M109A2/M109A3 models to M109A4 models.

2. On front cover beneath illustration of howitzer, add the following: "Approved for public release; distribution is unlimited."

3. New or changed material is indicated by a vertical bar in the outside margin of text changes and by a hand symbol beside illustration changes.

4. Remove old pages and insert new pages in manual as indicated below. File this change sheet in back of manual for reference.

Remove Pages	Insert Pages	Remove Pages	Insert Pages
i thru viii	i thru viii	1-37 thru 1-40	1-37 thru 1-40
1-1 thru 1-6	1-1 thru 1-6	1-45 thru 1-47/(1-48 blank)	1-45 thru 1-47/(1-48 blank)
1-17 thru 1-20	1-17 thru 1-20	2-29 and 2-30	2-29 and 2-30
None	1-20.1/(1-20.2 blank)	2-53 and 2-54	2-53 and 2-54
1-21 and 1-22	1-21 and 1-22	2-57 and 2-58	2-57 and 2-58
1-31 thru 1-34	1-31 thru 1-34	4-3 thru 4-6	4-3 thru 4-6

Remove Pages	Insert Pages
4-9 thru 4-16	4-9 thru 4-16
4-21 thru 4-32	4-21 thru 4-32
4-135 thru 4-138	4-135 thru 4-138
4-141 and 4-142	4-141 and 4-142
4-237 and 4-238	4-237 and 4-238
4-243 and 4-244	4-243 and 4-244
5-1 thru 5-12	5-1 thru 5-12
5-15 and 5-16	5-15 and 5-16
5-25 thru 5-28	5-25 thru 5-28
None	5-28.1 thru 5-28.4
5-29 and 5-30	5-29 and 5-30
5-53 and 5-54	5-53 and 5-54
5-73 thru 5-74	5-73 thru 5-74
5-155 thru 5-160	5-155 thru 5-160
None	5-160.1/(5-160.2 blank)
-171 and 5-172	5-171 and 5-172
5-191 and 5-192	5-191 and 5-192
6-3 thru 6-6	6-3 thru 6-6
6-21 and 6-22	6-21 and 6-22
None	6-22.1/(6-22.2 blank)
6-23 and 6-24	6-23 and 6-24
9-1 thru 9-4	9-1 thru 9-4
9-7 and 9-8	9-7 and 9-8
9-13 thru 9-16	9-13 thru 9-16
9-39 thru 9-48	9-39 thru 9-48
None	9-48.1 thru 9-48.8
9-49 thru 9-52	9-49 thru 9-52
9-63 and 9-64	9-63 and 9-64
9-67/(9-68 blank)	9-67/(9-68 blank)
10-3 and 10-4	10-3 and 10-4
10-7 and 10-8	10-7 and 10-8
13-1 thru 13-4	13-1 thru 13-4
13-7 and 13-8	13-7 and 13-8
C-1 thru C-3/(C-4 blank)	C-1 thru C-3/(C-4 blank)
D-1 and D-2	D-1 and D-2
None	D-2.1/(D-2.2 blank)
Index 1 thru Index 13/(Index 14 blank)	Index 1 thru Index 13/(Index 14 blank)
FP-1	FP-1 and FP-1.1
FP-2	FP-2 and FP-2.1

☆ U.S.GOVERNMENT PRINTING OFFICE : 1990 - 261-872 (20896)

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

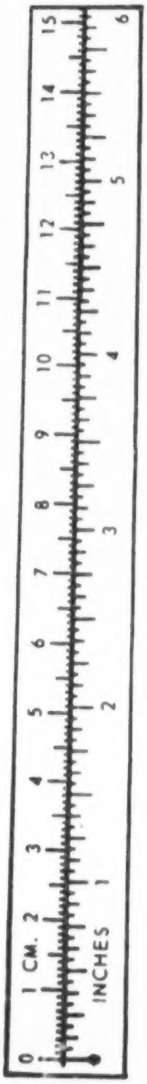
TEMPERATURE

$5/9\ (^{0}F - 32) = {}^{0}C$
212^{0} Fahrenheit is equivalent to 100^{0} Celsius
90^{0} Fahrenheit is equivalent to 32.2^{0} Celsius
32^{0} Fahrenheit is equivalent to 0^{0} Celsius
$9/5\ C^{0} + 32 = F^{0}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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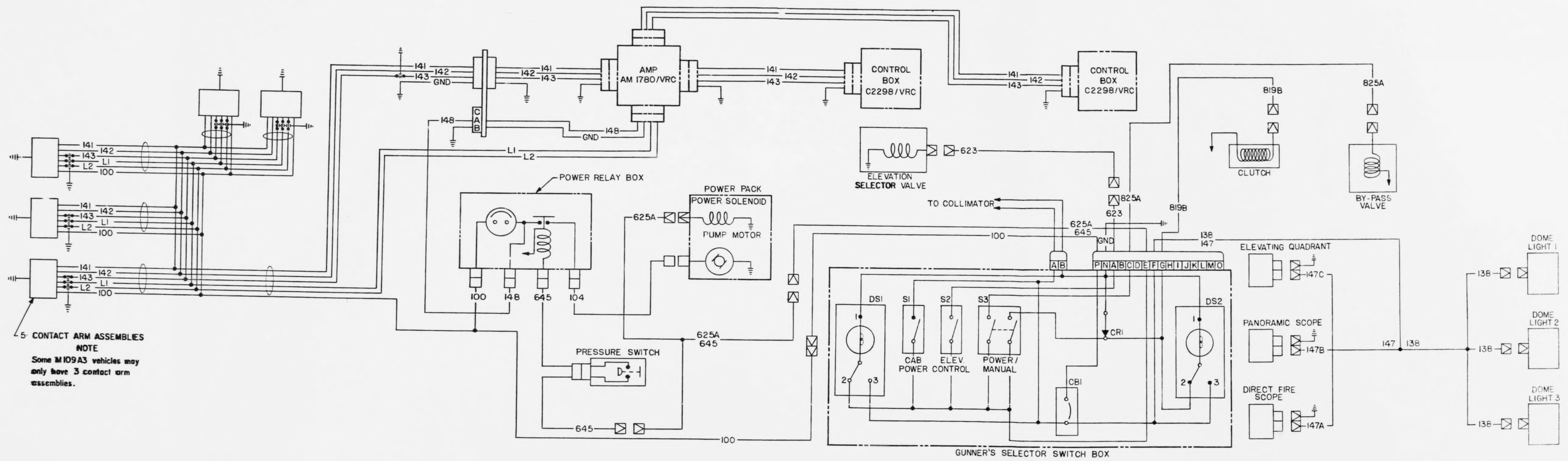

5 CONTACT ARM ASSEMBLIES
NOTE
Some M109A3 vehicles may only have 3 contact arm assemblies.
141
142
143
L1
L2
100
GND
148
CAB
AMP
AM 1780/VRC
CONTROL BOX
C2298/VRC
CONTROL BOX
C2298/VRC
POWER RELAY BOX
POWER PACK
POWER SOLENOID
PUMP MOTOR
625A
645
104
PRESSURE SWITCH
ELEVATION SELECTOR VALVE
623
TO COLLIMATOR
825A
819B
CLUTCH
BY-PASS VALVE
138
147
A B
P N A B C D E F G H I J K L M O
DS1
S1
S2
S3
CAB POWER
ELEV CONTROL
POWER/MANUAL
CR1
CB1
DS2
GUNNER'S SELECTOR SWITCH BOX
ELEVATING QUADRANT
147C
PANORAMIC SCOPE
147B
DIRECT FIRE SCOPE
147A
DOME LIGHT 1
DOME LIGHT 2
DOME LIGHT 3

Figure FO-1.

CAB ELECTRICAL SCHEMATIC (M109A2/M109A3)

best copy available

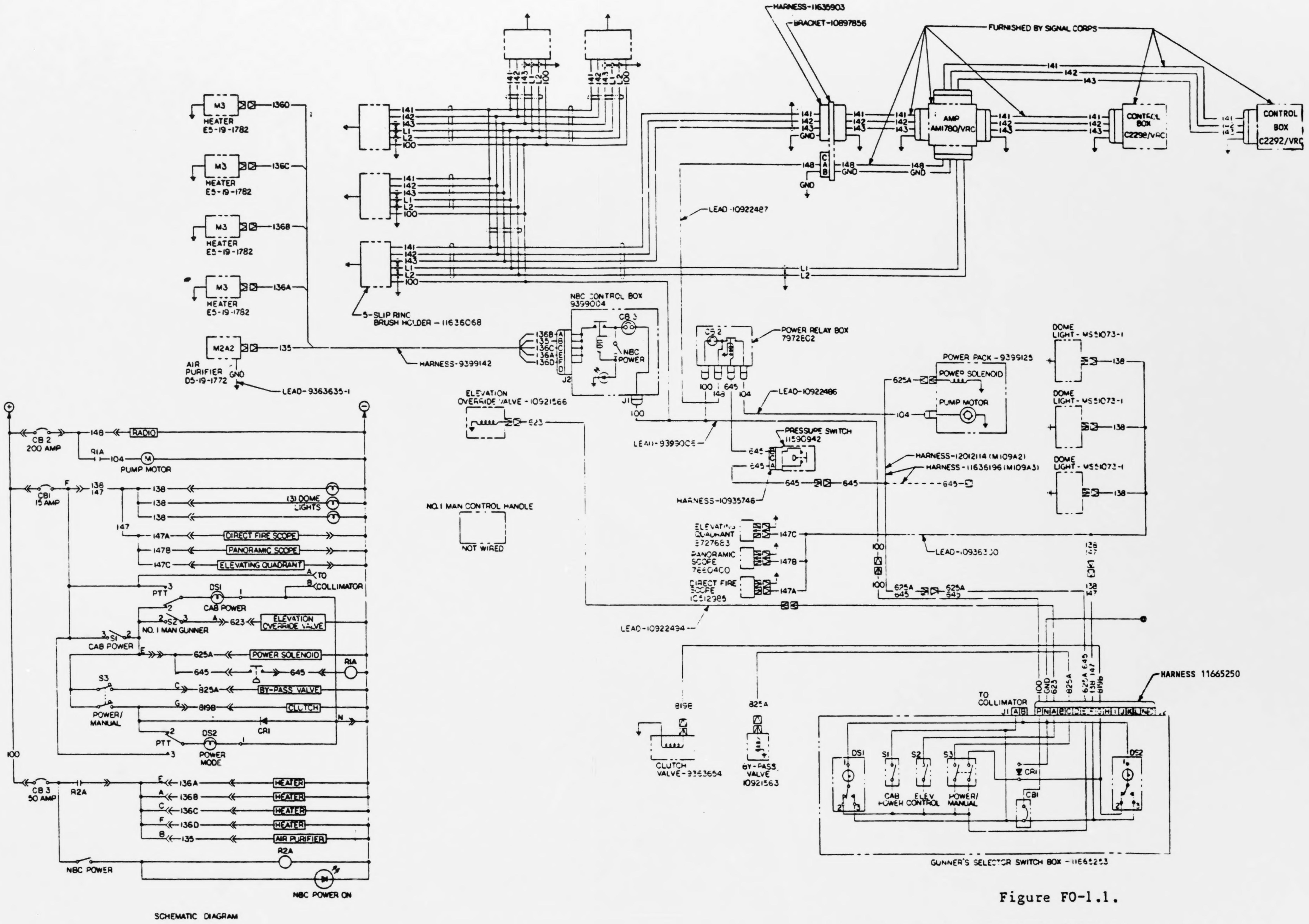

HARNESS-11635903
BRACKET-10897856
FURNISHED BY SIGNAL CORPS
AMP AM1780/VRC
CONTROL BOX C2292/VRC
CONTROL BOX C2292/VRC
141
142
143
GND
148
L1
L2
100
LEAD-10922487
M3 HEATER E5-19-1782
136D
136C
136B
136A
M2A2
AIR PURIFIER D5-19-1772
135
GND
LEAD-9363635-1
5-SLIP RING BRUSH HOLDER - 11636068
HARNESS-9399142
NBC CONTROL BOX 9399004
CB 3
NBC POWER
J2
J1
POWER RELAY BOX 7972EC2
CB 2
LEAD-10922486
LEAD-9399006
PRESSURE SWITCH 11590942
HARNESS-12012114 (M109A2)
HARNESS-11636196 (M109A3)
HARNESS-10935746
645
104
625A
POWER PACK - 9399125
POWER SOLENOID
PUMP MOTOR
DOME LIGHT - MS51073-1
138
ELEVATION OVERRIDE VALVE - 10921566
623
NO. 1 MAN CONTROL HANDLE
NOT WIRED
ELEVATION QUADRANT 7727663
PANORAMIC SCOPE 7660400
DIRECT FIRE SCOPE 10512985
147C
147B
147A
LEAD-10936300
LEAD-10922494
HARNESS 11665250
TO COLLIMATOR
819B
825A
CLUTCH VALVE - 7353654
BY-PASS VALVE 10921563
DS1
S1
S2
S3
CR1
CB1
DS2
CAB POWER
ELEV CONTROL
POWER/MANUAL
GUNNER'S SELECTOR SWITCH BOX - 11665253
CB 2 200 AMP
RADIO
91A
PUMP MOTOR
CB1 15 AMP
(3) DOME LIGHTS
DIRECT FIRE SCOPE
PANORAMIC SCOPE
ELEVATING QUADRANT
TO COLLIMATOR
PTT
CAB POWER
NO. 1 MAN GUNNER
ELEVATION OVERRIDE VALVE
POWER SOLENOID
R1A
BY-PASS VALVE
CLUTCH
POWER/MANUAL
POWER MODE
CB 3 50 AMP
R2A
HEATER
AIR PURIFIER
NBC POWER
NBC POWER ON
SCHEMATIC DIAGRAM

Figure FO-1.1.

CAB ELECTRICAL SCHEMATIC (M109A4)

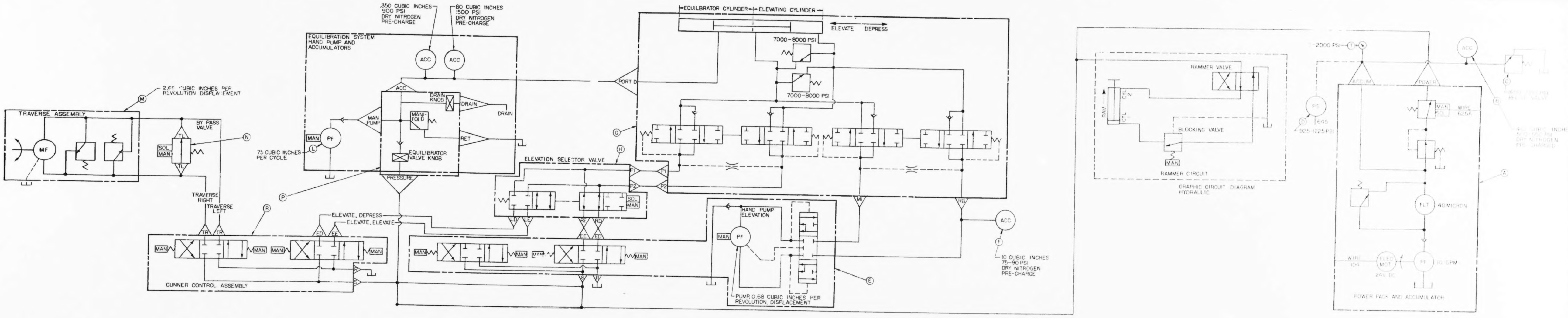

TRAVERSE ASSEMBLY
MF
2.65 CUBIC INCHES PER REVOLUTION DISPLACEMENT
M
BY PASS VALVE
TL
SOL
MAN
N
TRAVERSE RIGHT
TRAVERSE LEFT
R
TR
ED
EE
ELEVATE, DEPRESS
ELEVATE, ELEVATE
MAN
R
S
GUNNER CONTROL ASSEMBLY
EQUILIBRATION SYSTEM HAND PUMP AND ACCUMULATORS
.350 CUBIC INCHES 900 PSI DRY NITROGEN PRE-CHARGE
60 CUBIC INCHES 1500 PSI DRY NITROGEN PRE-CHARGE
ACC
DRAIN KNOB
DRAIN
MAN PUMP
MANI-FOLD
RET
PF
L
75 CUBIC INCHES PER CYCLE
EQUILIBRATOR VALVE KNOB
PRESSURE
P
EQUILBRATOR CYLINDER
ELEVATING CYLINDER
ELEVATE
DEPRESS
7000-8000 PSI
7000-8000 PSI
PORT D
G
H
ELEVATION SELECTOR VALVE
P1
P2
LD
LE
RE
RD
MI
RB
HAND PUMP ELEVATION
PUMP, 0.68 CUBIC INCHES PER REVOLUTION, DISPLACEMENT
E
F
10 CUBIC INCHES 75-90 PSI DRY NITROGEN PRE-CHARGE
RAMMER VALVE
RAM
CYL 2
CYL 1
BLOCKING VALVE
RAMMER CIRCUIT
GRAPHIC CIRCUIT DIAGRAM HYDRAULIC
2000 PSI
T
ACCUM
POWER
PS
D
645
925-1225 PSI
C
RELIEF VALVE
B
CUBIC INCHES
500-550 PSI
DRY NITROGEN
PRE-CHARGED
WIRE 625A
FLT
40 MICRON
A
WIRE 104
ELEC MOT
24V DC
10 GPM
POWER PACK AND ACCUMULATOR

Figure FO-2.

CAB HYDRAULIC SCHEMATIC (M109A2/M109A3)

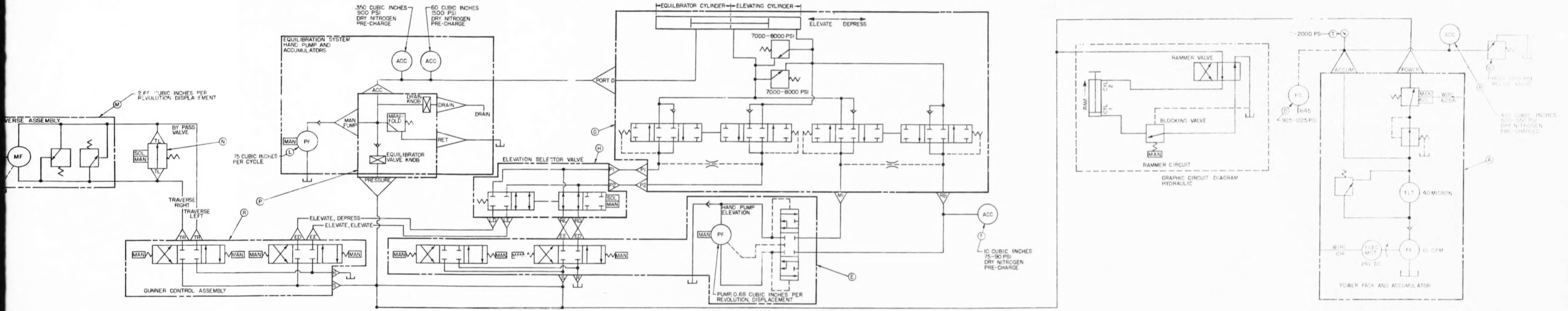
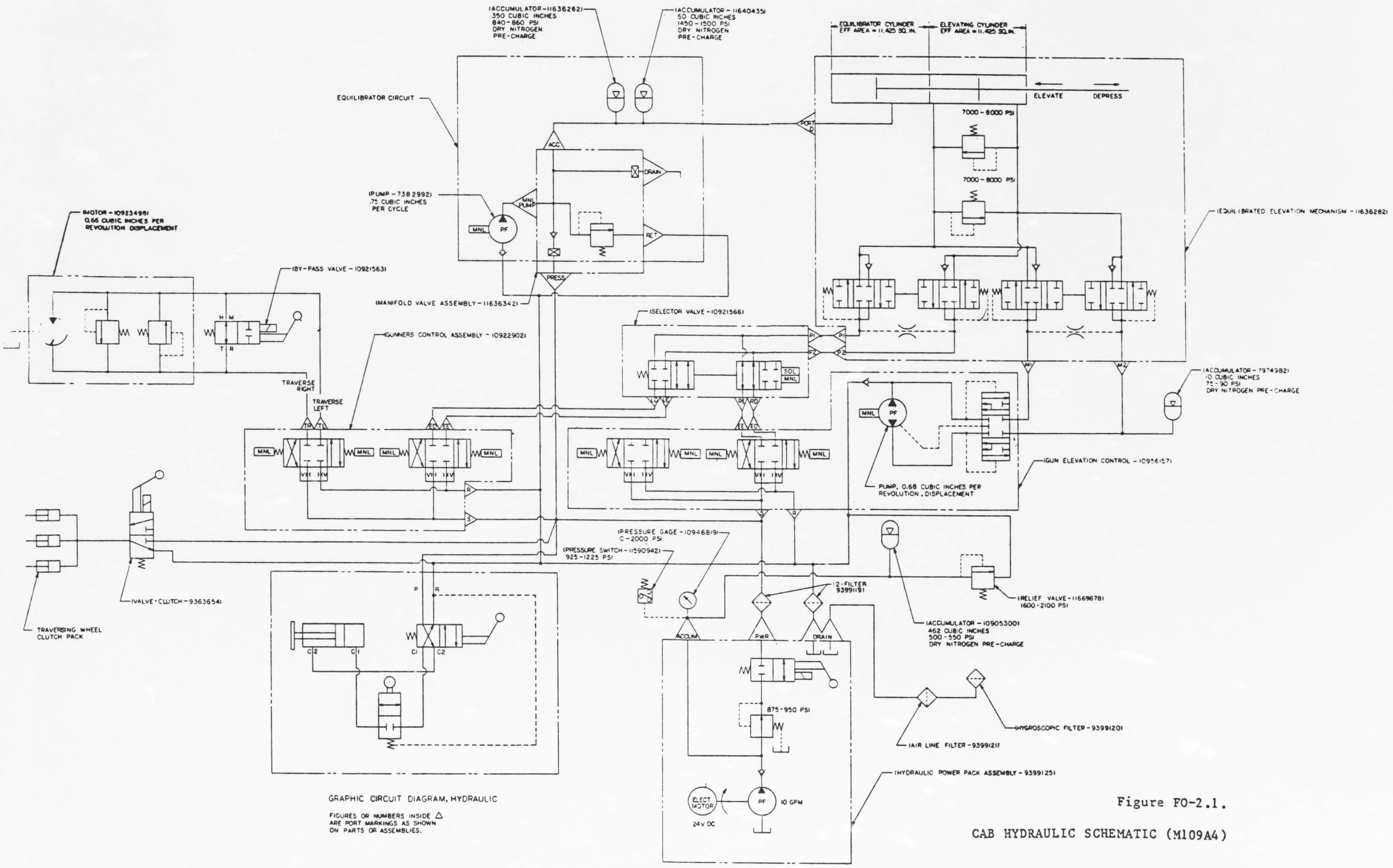

2.66 CUBIC INCHES PER REVOLUTION DISPLACEMENT
M
VERSE ASSEMBLY
MF
BY PASS VALVE
TL
SOL
MAN
TL
N
TRAVERSE RIGHT
TRAVERSE LEFT
R
TR
TR
MAN
MAN
MAN
MAN
ED
EE
ELEVATE, DEPRESS
ELEVATE, ELEVATE
R
S
GUNNER CONTROL ASSEMBLY
.350 CUBIC INCHES 900 PSI DRY NITROGEN PRE-CHARGE
60 CUBIC INCHES 1500 PSI DRY NITROGEN PRE-CHARGE
EQUILIBRATION SYSTEM HAND PUMP AND ACCUMULATORS
ACC
ACC
ACC
DRAIN KNOB
DRAIN
DRAIN
MAN PUMP
MANIFOLD
RET
MAN
PF
L
75 CUBIC INCHES PER CYCLE
EQUILIBRATOR VALVE KNOB
PRESSURE
P
EQUILBRATOR CYLINDER
ELEVATING CYLINDER
ELEVATE
DEPRESS
7000-8000 PSI
7000-8000 PSI
PORT D
G
H
ELEVATION SELECTOR VALVE
P1
P1
P2
P2
SOL
MAN
LD
LE
RE
RD
EE
ED
MAN
MAN
MAN
MAN
S
R
HAND PUMP ELEVATION
MAN
PF
PUMP, 0.68 CUBIC INCHES PER REVOLUTION, DISPLACEMENT
E
MI
RB
ACC
F
10 CUBIC INCHES 75-90 PSI DRY NITROGEN PRE-CHARGE
RAMMER VALVE
RAM
CYL 2
CYL 1
BLOCKING VALVE
MAN
RAMMER CIRCUIT
GRAPHIC CIRCUIT DIAGRAM HYDRAULIC
2000 PSI
T
PS
D
645
925-1225 PSI
ACCUM
POWER
ACC
C
1600-1800 PSI RELIEF VALVE
B
400 CUBIC INCHES 500-550 PSI DRY NITROGEN PRE-CHARGED
MAN
SOL
WIRE 625A
A
FLT
40 MICRON
WIRE 104
ELEC MOT
24V DC
PF
10 GPM
POWER PACK AND ACCUMULATOR

Figure FO-2.

CAB HYDRAULIC SCHEMATIC (M109A2/M109A3)


(ACCUMULATOR-11636262)
350 CUBIC INCHES
840-860 PSI
DRY NITROGEN
PRE-CHARGE
(ACCUMULATOR - 11640435)
50 CUBIC INCHES
1450 - 1500 PSI
DRY NITROGEN
PRE-CHARGE
EQUILIBRATOR CYLINDER
EFF AREA = 11.425 SQ. IN.
ELEVATING CYLINDER
EFF AREA = 11.425 SQ. IN.
ELEVATE
DEPRESS
EQUILIBRATOR CIRCUIT
ACC
DRAIN
PORT D
7000 - 8000 PSI
7000 - 8000 PSI
(PUMP - 7382992)
.75 CUBIC INCHES
PER CYCLE
MNL
PF
MNL PUMP
RET
PRESS
(MOTOR - 10923499)
0.66 CUBIC INCHES PER
REVOLUTION DISPLACEMENT
(BY-PASS VALVE - 10921563)
H M
T R
(MANIFOLD VALVE ASSEMBLY - 11636342)
(EQUILIBRATED ELEVATION MECHANISM - 11636282)
(SELECTOR VALVE - 10921566)
P1
P2
P1
P2
SOL
MNL
M1
M2
LC
LE
RE
RD
EE
ED
(GUNNERS CONTROL ASSEMBLY - 10922902)
TRAVERSE RIGHT
TRAVERSE LEFT
TR
TL
EC
EE
MNL
VH
HV
R
S
(ACCUMULATOR - 7974982)
10 CUBIC INCHES
75 - 90 PSI
DRY NITROGEN PRE-CHARGE
(GUN ELEVATION CONTROL - 10956157)
PUMP, 0.68 CUBIC INCHES PER
REVOLUTION, DISPLACEMENT
(PRESSURE GAGE - 10946819)
C - 2000 PSI
(PRESSURE SWITCH - 11590942)
925 - 1225 PSI
(2-FILTER
9399119)
(RELIEF VALVE - 11669678)
1600 - 2100 PSI
(ACCUMULATOR - 10905300)
462 CUBIC INCHES
500 - 550 PSI
DRY NITROGEN PRE-CHARGE
(VALVE-CLUTCH - 9363654)
TRAVERSING WHEEL
CLUTCH PACK
P
R
C2
C1
C1
C2
ACCUM
PWR
DRAIN
875-950 PSI
(AIR LINE FILTER - 9399121)
(HYGROSCOPIC FILTER - 9399120)
(HYDRAULIC POWER PACK ASSEMBLY - 9399125)
ELECT MOTOR
24V DC
PF
10 GPM

GRAPHIC CIRCUIT DIAGRAM, HYDRAULIC

FIGURES OR NUMBERS INSIDE △
ARE PORT MARKINGS AS SHOWN
ON PARTS OR ASSEMBLIES.

Figure FO-2.1.

CAB HYDRAULIC SCHEMATIC (M109A4)